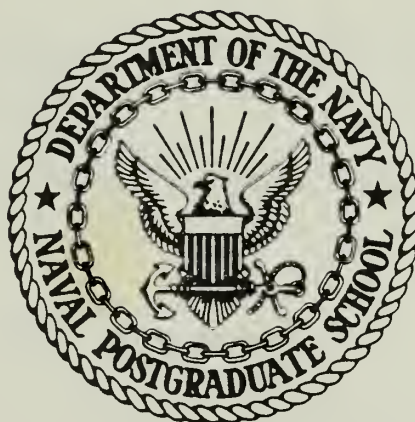


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THESIS

THE DEVELOPMENT OF A STANDARD DATABASE FOR
REPUBLIC OF KOREA ARMY'S LOGISTICS
SUPPORT SYSTEM

by

Lee, Hee Young
and
Song, Wha Dal

March 1985

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Database design is a two-phased process, and here are examined both logical and physical database design processes. These processes are an iterative process to get optimal design. Normal forms can be applied to decrease inefficiency of the relational database model in the system design process.

A sample database using dBASE II is implemented with IBM PC, and is designed for the user who does not have computer experience.

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The Development of a Standard Database
for
Republic of Korea Army's Logistics Support System
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Submitted in partial fulfillment of the
requirements for the degree of
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March 1985

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I. INTRODUCTION

A great deal of data and information is disseminated daily, and it better everyone's lives. To keep track of this information, it is necessary to memorize it. It is very hard for everybody to remember all this data and information, so computers were invented. Using the computer, information systems can be constructed to gather, arrange and calculate all important data and information in magnetic disk or tape files.

Information systems can distribute all the necessary data to people who need it whenever they want it. This type of computer system is called a DATABASE system. It is an integrated collection of stored files that contain data used to operate an organization. Database systems also provide reliable information to users when they need it and maintain current available data.

From the 1970s, DB systems were considered an esoteric subject, of interest only to the largest corporations with the largest computers. Today, DB systems are becoming an information systems standard. DB processing has grown significantly in the computer science area and also in management of certain organizations.

An important consideration in database development is to store data in such a way that it can be used for a wide variety of applications and can be changed quickly and easily. To achieve the flexibility of data usage, three aspects of DB design and implementation are important. First, the data should be independent of each other and functionally dependent on the key value. Second, it should be possible to interrogate for user's requirements using application programs or the DBMS itself. Third, these data

items should provide useful information for decision makers to analyze, to investigation, to plan and to manage in a certain organization.

It is very difficult to develop DB system which perform in an optimal fashion. There are many different ways in which data can be structured and each has its own advantages and disadvantages. Different users want to use different data/information. It is hardly possible to satisfy all of the users with one type of data organization.

The normal form concepts of relational database will be used to develop an intelligence database, because the relational database management system supports independence better than other models and is easier to implement.

Chapter II addresses the background, which relates to the database system development for the Korean army's logistics support system requirements. Chapter III defines fundamental concepts of database, and include a general overview of a DB system and its protection. Chapter IV discusses an introduction to database design, both logical and physical, and describes database models and selection that are useful for Korean army logistics support systems. Chapter V presents a relational database design for the Korean army 2nd logistics support command, which includes relational normal forms and the characteristics of the relational database. Chapter VI addresses the implementation of a logistics system in the Korean army using the relational DBMS product DBASE II. Finally, Chapter VII presents conclusion and recommendations based on the research presented in the thesis.

The RUC Field Ground Forces Logistics
GENERAL
(2) Logistics Mission:

II. BACKGROUND

A. OVERVIEW

The republic of Korea (ROK) army uses the general staff system of the U.S.A field Armies, corps, and divisions, namely, G-1, personnel; G-2, intelligence; G-3, operations and training; and G-4, logistics.

The Korean army is the largest organization in Korea. In national security, the position of the Korean army is very important. It stands face to face with communist north Korea on the 155 mile long DMZ. In order to strengthen the war potential of the Korean army, it is imperative that the management of the logistics support system be performed very efficiently.

However, manually managing all army logistics system is a very tedious, complex, and time-consuming job. The army logistics system deals with approximately 200,000 items. In order to reduce time, overhead and the national defense expenditure, and increase the war power, the army needs a computerized management information system for army logistics system management. Top-level Korean army officers are very interested in a computer database system to maintain the status of all items handled by the army logistics system.

The Korean army installed its first computer system in the data processing center (DPC) of the logistics command in 1973. The center, however, did not become fully operational until 1974.

D.B. LOGISTICS STRUCTURE

The primary mission of logistics is to insure the operation of weapons on the battlefield. Logistics encompasses a broad spectrum of functions and responsibilities which are required in order that the ultimate objective can be achieved.

Basically, logistics can be described as an effort to develop and maintain maximum combat power through the support of weapon systems.

Just as the army itself is a composite defense system, the system which keeps it supplied and operational is a composite of material, personnel and facilities, processes and organizations, and different levels and varieties of activities, all in motion together and all merging in the common and basic objective of meeting the requirements of the forces.

In considering how to manage for army logistics, five categories can be listed, These are facilities management, finance management, material supply management, service management, and personnel management. Logistics usually deal with material supply management that includes the following principal functions : requirement, procurement(acquisition), storage and distribution, maintenance while in storage, and salvage of supplies including the determination of quantities of supplies.

There are three major echelons of logistics support which are determined by types of work done at each echelon.

- * Wholesale echelon
- * Intermediate echelon
- * Direct support/user echelon

Wholesale echelon includes depots, maintenance points, plants and factories associated with special army activities retained under army headquarters.

Intermediate echelon provides the major interface between the wholesale and direct support/user echelon. It includes units in the field which provide general support supply, maintenance, transportation, facilities and services.

Direct support/user echelon includes fields units which provide direct support supply, maintenance, transportation and services. Users include the combat, combat support, and combat service support units utilizing the services and equipment which are the responsibilities of the logisticians.

The current Logistics and Background

C. CURRENT LOGISTICS SITUATION IN KOREA

The first computer introduced in Korea was the IBM 360/40 (64 KB) which came from the U.S in March 1967. Its purpose was to survey the entire population of Korea. The Korean army installed its first computer system in 1972 to organize the military personnel system. Next year, another computer was installed for the logistics system that were mentioned before.

The Korean army used the computer relatively early. Several computer centers were installed by the ROK army. There are several types of computer centers. The type of computer center is determined by the purpose of use - education, personnel, logistics, intelligence, finance and national security, etc. All the computer centers are directly controlled by the staff of ROK army headquarters. There is one integrated software development center which is located in headquarter of ROK army.

Each of the computer centers has different hardware systems, and applications with file systems have been individually designed, developed and operated by the different operating systems.

The army logistics computer system is the largest system among the different types of computer system. The logistics computer system, can be divided hierarchically following different level computer system: (1) department of computer system control in army headquarters, (2) logistics information system center in logistics command, (3) and data processing center in logistics support command which is located three different place to support units which are in same area.

Further down at the division level including corps, management of the logistics operations is accomplished monitoring the operational readiness of weapon system.

They use several languages, COBOL, Assembly language, and FORTRAN. 53% of total applications software is COBOL, 44% is Assembly language, and 3% is FORTRAN.

Nowadays, Assembly language tends not to be used to program. The percentage of COBOL will increase. They did not introduce more advanced higher level languages like PASCAL and Database languages.

Today computer hardware system consists of IBM370, UNIVAC90/30 and 1100 series. These computers are not on-line systems, but rather run batch jobs.

Applications systems are operated daily, weekly, monthly, and yearly depending upon the different reports. The files of the applications consist of indexed sequential access method (ISAM), sequential access method (SAM) or sequentially fixed-length records.

At present, many files of records are used in ROK army without database techniques. These files contain limited data items that personnel managers require. Several file systems provide information to be used for doing logistics management by spooling, time sharing, and virtual techniques.

In order to provide logistics managers who want to use information as soon as possible, ROK army logistics systems

must have a capability to provide reliable information with efficient processing. this is complicated by the fact that the application systems use several different file system.

The problem of the file system are as follows [Ref. 15],

First, there is a high level of redundancy. There are several of the same kind of data items among personnel system, payroll system, PX system, inventory system, military medical system, etc.

These common data items are updated independently in each file system. It is very hard to maintain the accuracy of a common data item on different file systems. Furthermore, the number of files for application will be more and more.

Second, the file systems are inflexible requests for information from a wide range of users are impossible to answer within given time. Even though the file systems contain data items for producing information to be provided, information can not be provided relating to those data items. The data can not be processed without reconstruction. Although millions have been paid for computer system, the information can not be obtained when it is needed.

Third, it can be expensive to make changes to a file system. According to the requests of users, a file system can be changed or modified. Sometimes the modifications are difficult because the applications were not adequately documented for other programs. As time goes on, the problem becomes worse because more programs are created or modified. And, whenever a file is changed, programs for that file system have to be changed or modified. Additionally, individually developed file systems and non-standardized hardware systems do not help to achieve data communications with each other.

Recently, higher managers have recognized the need for the standardization of hardware and the unification of application softwares. One department, software developing department, that directly manages to develop application systems and programs was formed.

D. ADF SUPPORT

The ADPC (Automatic Data Processing Center) within the logistics structure provides significant support. In order to effectively command and control any operations, the commander must have adequate visibility.

The use of automatic data processing (ADP) systems has significantly increased the commander's visibility and has had an effect on logistics operations.

The ADPC dedicated to the logistics operations supports its own internal functions such as stock controls within its area of responsibility and a routine report for higher command.

In order to produce many different reports which higher level managers need, this system uses file systems which include several files such as all item's master file, storage by depot file, due-in file, due-out file, fund resource file, fund ceiling control file, material ceiling control file, demand file, item's location file, OST file, Army equipment file, etc.

Most are basic files among all files. Some are transaction files or sort files which are a relatively temporary files containing data about transactions and sorting of working activities.

From these files, army logistics ADP system controls asset management that includes requisition and issue, due-in, due-out management, report and documentations management, fund and material management, requirement

management, storage management, Army equipment management, automatic return management, etc.

This ADP system generates many different reports which are made by result from running computer system. These reports are produced periodically as required for higher officers who work in the Army logistics field.

these reports show by the title, the generation time, the number of copies, contents of each report, their use, etc. These are also designed to provide up-to-date accurate status data for selected items or units.

III. BASIC CONCEPT OF DATABASE

A. WHAT IS A DATABASE?

A much-publicized but impracticable idea of a database says that a corporation keeps all its processable items of data in a large storage in which diversity of data users can be accessed. The storage in which all the data are kept may be in one location or multiple locations, the latter possibly interconnected by telecommunications. Programs for a variety of applications have access to the data.

A database may be defined as a collection of interrelated data stored together without harmful or unnecessary redundancy to serve multiple applications; the data are stored so that they are independent of programs which use the data; a common and controlled approach is used in adding new data and in modifying and retrieving existing data within the data base. The data is structured so as to provide a foundation for future application development. One system is said to contain a collection of data bases that are entirely separate in structure [Ref. 1].

Also according to [Ref. 2], the definition of database is a collection of stored operational data used by the application systems of some particular enterprise (e.g. manufacturing companies, banks, hospitals, etc.). And database systems are nothing more than a computer-based record keeping system: that is, a system whose overall purpose is to record and maintain information.

B. ADVANTAGES AND DISADVANTAGE

A database is needed to provide the enterprise with centralized control of its operational data. This is in

sharp contrast to the situation that prevails in most enterprises today, where typically each application has its own private files so that the operational data is widely dispersed, and there is little or no attempt to control it in a systematic way [Ref. 2].

The database processing have many advantages and also many disadvantages [Ref. 3]. First, the advantage of database processing enables more information to be produced from a given amount of data. Second, the elimination or reduction of data duplication saves file space, and to some extent, can reduce processing requirements. The most serious problem of data duplication is that it can lead to a lack of data integrity. A common result of this is conflicting results. Third, creation of program/data independence dose not create problems when a file is changed. It means that the application concerned do not depend on any one particular storage structure and access storatge. The fourth advantage is better data management. When data are centralized in database, one department can specialize in the maintenance of data. That department can specify data standards and ensure that all data adhere to the standards. When someone has a data requirement, he or she can contact one department instead of many file maintenance groups. There is only one DBMS processing a shared database, and improvements made to the database or to the DBMS will benefit many users. The other advantages of database processings allow query languages for easy "one-shot" programs and make it easier to retrieve sophisticated information in a DBMS environment.

A major disadvantage of database processing is that it can be expensive. The DBMS may occupy much main memory, and software purchase costs are high. Once the database is implemented, operating and administrative costs for some systems will be higher. Also, more sophisticated computer personnel are required to operate a DBMS. Second, a DBMS

environment is more complex for personnel who must manage the system and data. Large amounts of data in many different formats can be interrelated in the database. Third, backup and recovery are more difficult, because of increased complexity and because databases are often processed by several users concurrently. Fourth, the system is more vulnerable to failure, because all data are centralized and under one system. Another disadvantage of DBMS is likely to be slower and more expensive than a file system "tuned" to a particular application.

C. AN ARCHITECTURE FOR A DATABASE SYSTEM

The aim of presenting architecture is to provide a framework which is useful for describing general concepts and the structure of individual systems. But every database system can not be neatly matched to this particular framework.

The architecture is divided into three general levels: internal, conceptual and external in figure 3.1 [Ref. 2,5]. Broadly speaking, the internal is the one closest to physical storage, the one concerned with the way in which the data are actually stored; the external level is the one concerned with the way in which the data are viewed by individual users; and the conceptual level is a "level of indirection" between the other two.

X Next, the various components of the system will be examined. The users are either application programmers or remote terminal users of any degree of sophistication. Each user has a language at his disposal. It will be a conventional programming language, such as COBOL, PL/1, PASCAL, etc.

Each external model is defined by means of an external schema, which consists of descriptions of each the various types of external records in that external model. In

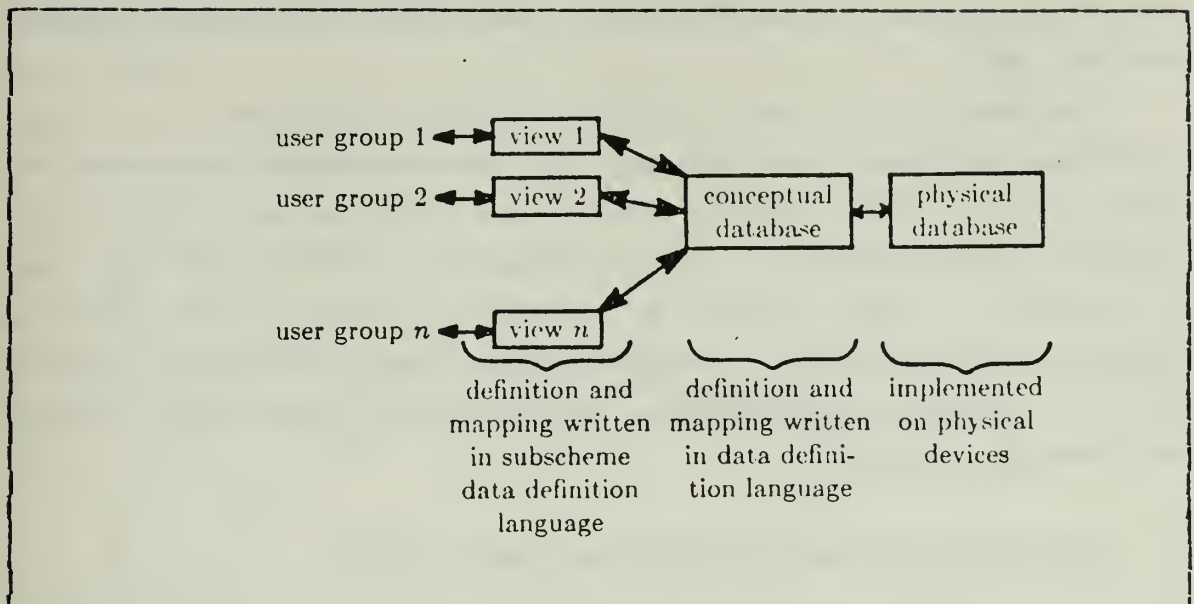


Figure 3.1 The Three Levels of the Architecture

addition, there must be a definition of the mapping between the external schema and the underlying conceptual schema.

The conceptual model is a representation of the entire information content of the database, ~~again in a form that is~~ somewhat abstract in comparison with the way in which the data is physically stored. ~~The conceptual model is defined by means of the (conceptual schema), which includes definitions of each of the various types of conceptual records. This model is a view of the total database content, and the (conceptual schema) is a definition of this view.~~ The definition in the conceptual schema is intended to include a great many additional features, such as the authorization checks and validation procedures.

The internal model is a very low-level representation of the entire database; It consists of multiple occurrences of multiple types of internal records. The internal model is described by means of the internal schema, which not only defines the various types of stored record but also fields

are represented, what physical sequence the stored records are in, etc.

The conceptual and internal mapping defines the correspondence between the data model and the stored database; it specifies how conceptual records and fields map into their stored counterparts. If the structure of the stored database is changed, that is, if a change is made to the storage structure definition, The conceptual and internal mapping must be changed accordingly, so that the conceptual schema may remain invariant.

D. COMPONENTS OF A BUSINESS DATABASE SYSTEM

A business database system is a collection of five components that interact to satisfy business needs. The five components are hardware, programs, data, people, and procedures [Ref. 3].

1. Hardware

A database system does not require a special type of hardware. And it can be used in mainframes, minis and micros. Database processing, however, does involve special programs and overhead data. Thus database applications often require more more hardware: more memory, a faster CPU, and more direct access storage.

Database machines are special-purpose computers that perform database processing functions. Also, ~~Hsiao defines a database machine as "specialized hardware supporting basic DBMS functions found in most contemporary software database management systems"~~ [Ref. 4]. As shown in figure 3.2, the computer processing the application program sends requests for service and data over a channel to the database machine. The machine processes the requests and sends results, data, or messages back to the main computer. Thus database

processing can be performed simultaneously with applications processing.

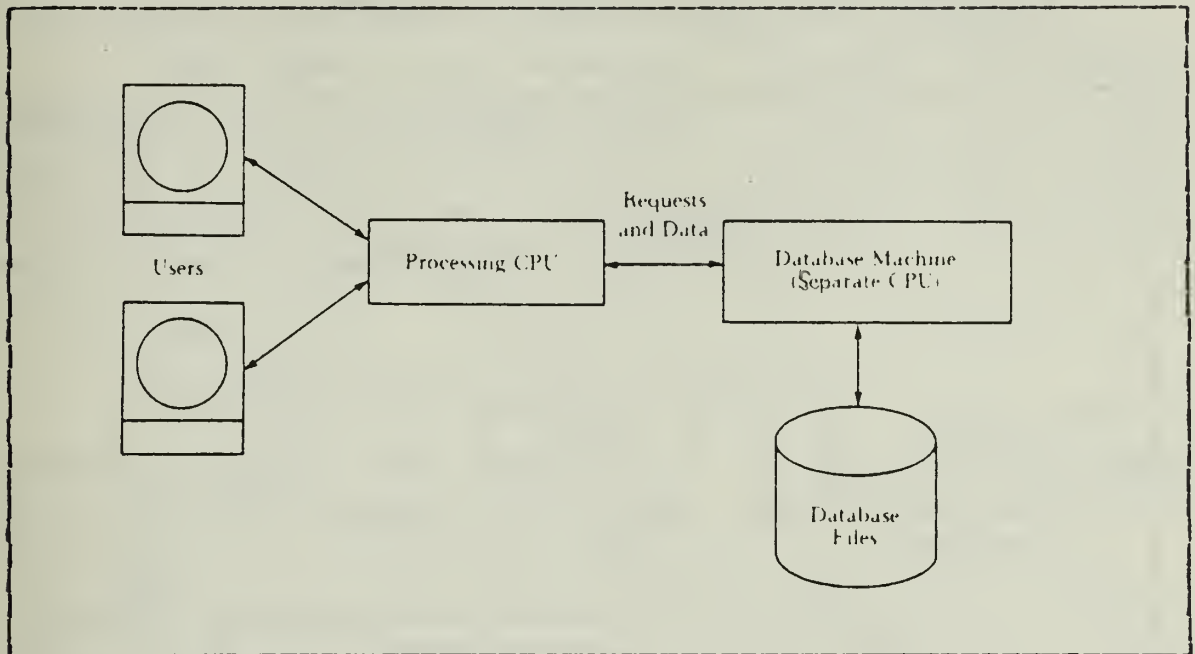


Figure 3.2 Schematic of Processing with Database Machine

2. Programs

There are several types of programs which are used in database processing systems. Figure 3.3 shows the approximate relationships of the major types. Online processing requests or transactions are provided by users at terminals. The requests are sent to the processing computer over communications lines.

The requests are received and routed by the Communications Control Program (CCP). It provides communication error checking and correction, coordinates terminal activity, routes messages to the correct next destination, formats messages for various types of terminal equipment, and performs other communication-oriented tasks.

The utility programs are provided by either the DBMS or the hardware vendor. These programs provide a wide variety of services. Query/update utilities provide generalized retrieval and update of the database.

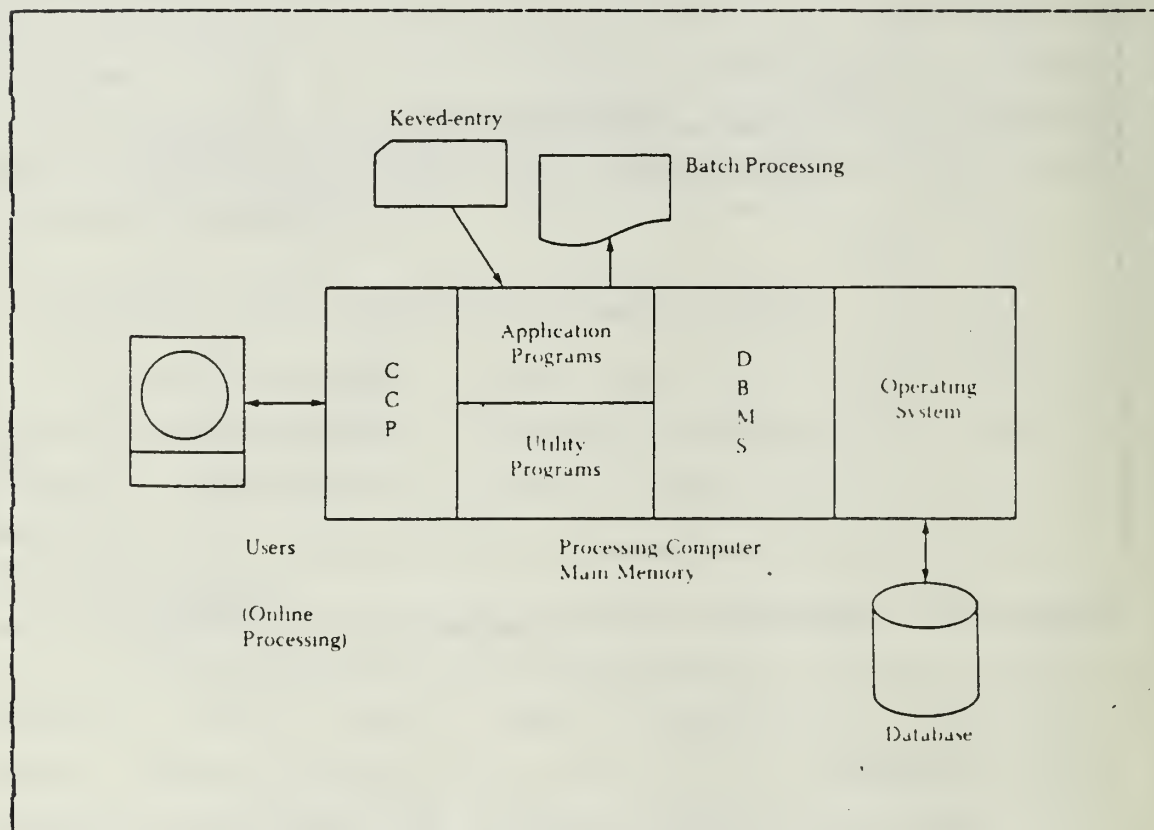


Figure 3.3 Programs Involved in Typical Database Processing

For normal processing, the DBMS receives data and stores it for subsequent processing. This system acts as a sophisticated data librarian. The DBMS allows application programs and utilities a wide variety of access storages. It also enables these programs to have different views of the same data so that applications can use data in a format that is familiar and useful to them.

The DBMS also has features to provide security over data; the tools provided ensure that only authorized data are accessed. Also, the DBMS controls concurrent processing and includes features to provide backup and recovery.

The final type of program involved in database processing is the operating system. This set of programs controls the computer's resources. The DBMS sends requests for input/output services to operating system. All programs are controlled by the operating system.

3. Data (3/50)

According to standard usage in the computer industry, BITS are grouped into BYTES or CHARACTERS, CHARACTERS are grouped into FIELDS, and FIELDS are grouped into RECORDS. A collection of records is call a FILE. A DATABASE is more than a collection of files; It is a collection of integrated files. Another way of saying this is that a database is a collection of files and relationships among records in those files.

Database records can be accessed sequentially within a file, randomly by value of field, or by relationship to other records.

A key is a field that is used to identify a record. For database processing, key can be unique or nonunique.

In a database system a variety of views of the data are defined. One is called the "schema" or "conceptual view". This is complete logical view of data. The term "logical" means the data as it would be presented to the human. The schema describes all of the data in the database.

Another type of view called a "subschemata", or external view defines a subset of the schema to be seen by a given application program or user.

A third view of the data ia called the "internal view", or sometimes, the physical view. This is the form of

the data as it appears to a particular processing computer. It describes how data is physically arranged and how it is allocated to files.

4. People (DBA)

Clientele are the people for whom the system is developed. The clientele of an airline reservation system are the people who take flights. The clientele of a payroll system are employees. Clientele do not usually have an active role in database system development or use.

Users are people who employ the system to satisfy a business need. The users of an airline reservation system are the clerks, the users of the payroll system are payroll administrators, clerks, and business managers.

Operations personnel run the computer and associated equipment. Typically, the operations department includes machine operators, data control personnel, and data entry people.

Systems development personnel design and implement the database system. They determine requirements, specify alternatives, design the five components of the system, and message systems implementation. The design of the database structure or schema is an important function of these people.

The final category of people in database applications is database administration (DBA) personnel. A database is a shared resource. The function of the DBA staff is to serve as a protector of the database and as a focal point for resolving user's conflicts. The DBA should be a representative of the community as a whole, and not of any particular user or group of users.

5. Procedures

Both users and the operations staff need documented procedures for normal conditions. The users need to know how to sign on the system, how to use the terminals, how to provide data, and so fourth. They also need procedures that ensure they do not interfere with one another.

File systems fail at some point, and when a database system fails, both users and operations personnel need procedures describing what to do. These procedures are especially important for database processing because so many applications are dependent on the database.

Database management procedures are needed for DBA and others because every business is a dynamic activity, and business needs will change.

E. DATABASE PROTECTION

1. Security

The subject of database security, the protection of the database against unauthorized use, has many different aspects and approaches. First, it is necessary to protect against both undesired modification and/or destruction of data and against unauthorized reading of data. Three techniques are described below [Ref. 5].:

- a. User identification --- The most common schema to identify users is a password known only to the system and the individual.
- b. Physical protection --- A high security system needs better identification than a password, such as personal recognition of the user by a guard.
- c. Maintenance and transmittal of rights --- The system needs to maintain a list of rights enjoyed by each user on each protected portion of the database.

2. Integrity Preservation

The term "integrity" is used in database contexts with the meaning of accuracy, correctness, or validity [Ref. 6]. This aspect concerns nonmalicious errors and their prevention. The problem of integrity is the problem of ensuring that the data in the database is accurate. Invalid updates may be caused by errors in data entry, by mistakes on the part of the operator or the application programmer, by system failures, even by deliberate falsification. The DEMS can help detect some programming bugs, such as a procedure that inserts a record with the same values in the key fields as a record that already exists in the database.

IV. INTRODUCTION TO DATABASE DESIGN

A. INTRODUCTION

A database is the interface between people and machines. The nature of these two components is utterly different. People are imprecise and intuitive, and their thinking is fuzzy. Machines are precise and predictable, and their processing is exact. The difficulty is to develop a database design which meets the needs of the people who will use it.

Database design is both art and science. Dealing with people, understanding what they want today, predicting what they will want tomorrow, differentiating between individual needs and community needs, and making appropriate design tradeoffs are artistic tasks. To accomplish these tasks, there are principles and tools, but these must be used in conjunction with intuition and guided by experience.

Database design is a two-phased process [Ref. 3]. First, one examines the user's requirements and build a conceptual database structure that is a model of the organization. This phase of database design is often called "logical database design". Once the logical database design is completed, this design is formulated in terms of a particular DBMS. Usually, compromises must be made. For example, the DBMS may not be able to express relationships precisely as the users see them. The process of formulating the logical design in terms of DBMS facilities is called "physical database design".

This chapter will introduce the two-phased process of database design. And then it will survey important design tools called database models.

B. LOGICAL DATABASE DESIGN

Database design is an intuitive and artistic process. There is no algorithm for it. Typically, database design is an iterative process; during each iteration, the goal is to get closer to an acceptable design. Thus a design will be developed and then reviewed. Defects in the design will be identified, and the design will be done. This process is repeated until the development team and users can find no major defects.

Figure 4.1 illustrates the flow of work in a typical database design project. User requirements are studied and a logical database design is developed. The preliminary design of database processing programs is produced. Next, the logical database and the preliminary program designs are used to develop the physical database design and the detailed program specifications. Finally, both of these are input to the implementation phase of the project.

1. Outputs

A logical database design specifies the logical format of the database. The RECORDS to be maintained, their contents, and RELATIONSHIPS among those records are specified. Industry uses various terms for this design. It is called the schema, the conceptual schema, the logical schema, and This thesis will use the term logical schema.

a. Logical database records --- To specify logical records, the designer must determine the level of detail of the database model. If the model highly aggregated and generalized, there will be few records. If the model is detailed, there will be many records. The database designer must examine the requirements to determine how coarse or how fine the database model should be.

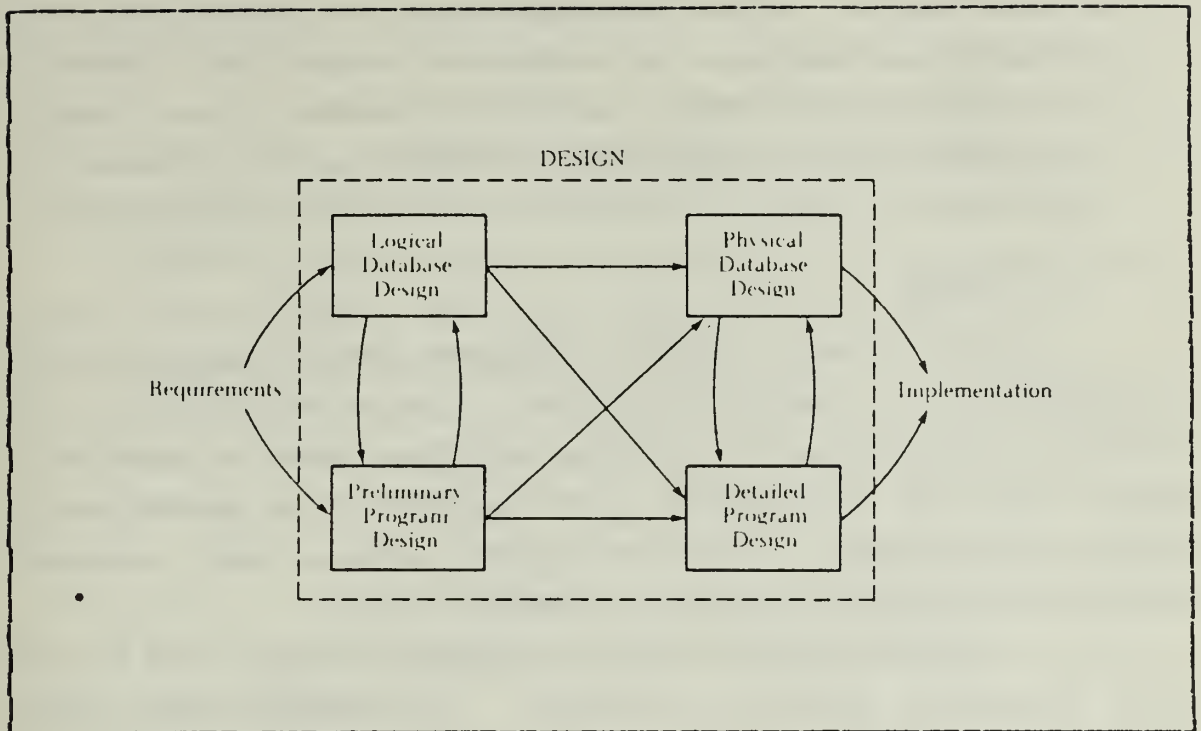


Figure 4.1 Database and Program Design Flow

The contents of these records are specified during logical design. Names of fields and their format must be determined. The designer must specify how much data will be maintained. Also, the format of data items is specified.

As the requirements are evaluated and the design progresses, CONSTRAINTS on data items will be identified. These constraints are limitations on the values that database data can have. Three types of constraints are common. FIELD constraints limit the values that a given data item can have. INTRARECORD constraints limit values between fields within a given record. INTERRECORD constraints limit values between fields in different records.

b. Logical database design relationships --- The essence of database is the representation of record

relationships. These relationships are specified during the logical design. The designer has to (a) determine one-to-one, one-to-many, and many-to-many relationships, (b) study the application environment, (c) examine the requirements, and (d) identify necessary relationships.

2. Inputs

The inputs to logical database design are the system requirements and the project plan. Requirements are determined by interviews with users, and that must be approved by both users and management. The project plan describes the system environment, the development plan, and constraints and limitations on the system design.

The requirement can be expressed in the form of data flow diagrams, policy statements, and the data dictionary. Contents of the data dictionary can be transformed into the logical and user views. Policy statements can be used to develop the descriptions of logical database processing. The requirements can be used to verify the completeness of the logical design.

3. Procedures for Logical Database Design

Many techniques have been defined for logical database design. Some are completely intuitive and others involve specific procedures for processing the data dictionary. The major steps in the logical design process are described below.

a. Identify data to be stored --- First, the data dictionary is processed, and that which is to be stored is identified and segregated. This is necessary because the data dictionary will contain descriptions of reports, and will screens, and input documents that will not be part of the database.

b. Consolidate and clarify data names --- One task is to identify synonyms, to decide on standard names for synonyms, and to record aliases (when synonyms cannot be eliminated, they are recorded as alternate names, or aliases).

Another task related to terminology is to ensure that data items having the same name are truly the same. If not, unique data item names will need to be developed.

c. Develop the logical schema --- This is developed by defining records and relationships. Records are defined by determining the data items they will contain. The design team examines the data flow diagrams and data dictionary, applies intuition to the business of setting up the new system, and determines that certain records will need to exist.

Some of these files may need to be combined, and others may need to be separated. Another problem regarding record definition concerns implied data. A data item is implied when it is needed to meet a requirement.

The second step in developing the logical schema is to determine relationships among database records. We want to model the way the users see the relationships. Generally, relationships are identified intuitively. At this point, the design team must discriminate between theoretical and useful relationships. A theoretical relationship can exist logically, but may never be needed in practice.

d. Define processing --- The requirements are examined to determine how the database should be manipulated to produce required results. The processing definitions can be developed in several ways. One method is to describe transactions and data to be modified. Another method is to develop structure charts of the programs that will access the database.

e. Design review -- The final stage of logical database design is a review. The logical schema and user views are examined in light of the requirements and program descriptions. Every attempt is made to identify omissions, unworkable aspects, or other flaws in the design. Typically, a panel of independent data processing people is convened for this review. Documentation of the logical schema, user views and program description is examined by the panel and oral presentations are evaluated. The purpose of the review is to identify flaws, not to solve them.

C. PHYSICAL DATABASE DESIGN

The second stage of database design--physical design is a stage of transformation. The logical schema is transformed into the particular data constructs that are available with the DBMS to be used. Whereas the logical design is DBMS-independent, the physical design is very much DBMS-dependent.

Detailed specifications of the database structure are produced. These specifications will be used during the database implementation to write source statements that define the database structure to the DBMS. These statements will be compiled by the DBMS and the object form of the database structure will be stored within the database. See Figure 4.2.

1. Output of Physical Database Design

Specific constructs vary widely from one DBMS to another. In general, two major specifications are produced. First, the physical specification of the logical schema is defined. This specification is called the PHYSICAL SCHEMA. This schema is a transformation of the logical schema into

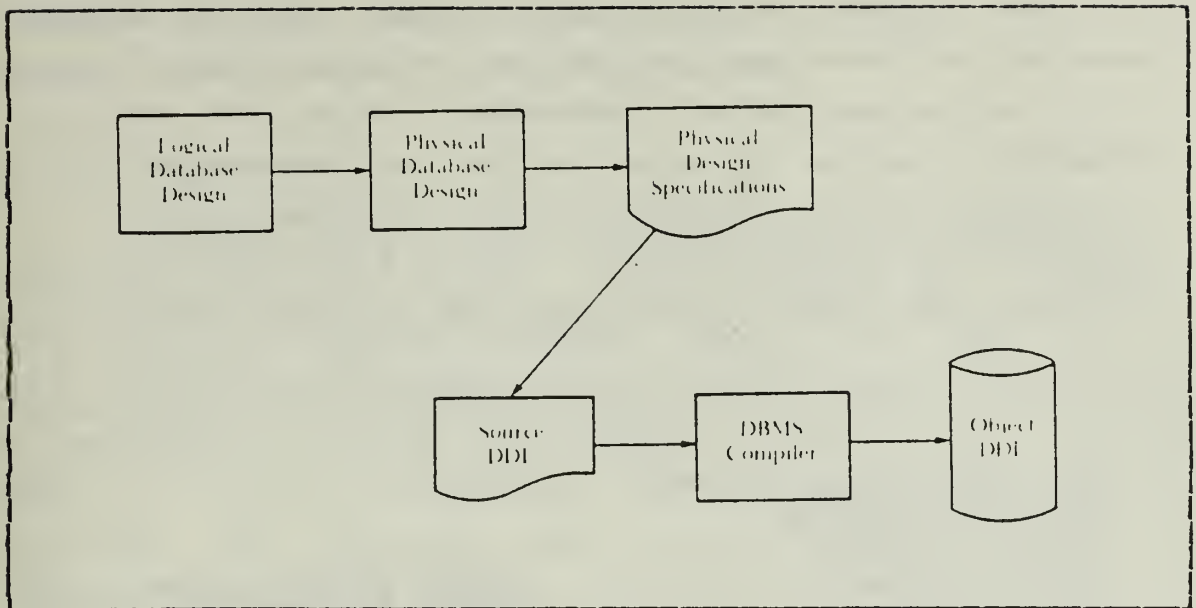


Figure 4.2 Role of Physical Design

the data modeling constructs available with the DBMS to be used. Second, user views are defined.

a. Physical schema --- Figure 4.3a lists generic items that are defined in a physical schema design. The contents of each record must be defined, and the name and format of each field of each record specified. Constraints from the logical database design are transformed into criteria for field descriptions. Keys of database records need to be identified, and overhead structures for supporting the keys defined.

Record relationships are also defined in the physical design. Limitations in the DBMS may necessitate that record relationships be changed from what the user wanted. A many-to-many relationship may need to be changed to a simple network.

b. User view --- Most users will need to view only a portion of the database, the logical database design must specify which user groups will view which portions of database.

User views are generally a subset of the schema. Records or relationships may be omitted from a view; field may be omitted or rearranged. Also, the names of records, fields, or relationships may be changed. This flexibility allow users to employ terminology that is familiar and useful to them. Figure 4.3b lists items to be defined for user views during the physical design.

| | |
|--------------------------|---------------------|
| Name of physical schema | |
| Names of records | |
| Format of records | |
| Names of fields | |
| Format of fieds | |
| Constraints | |
| Names of keys | |
| Supporting overhead data | |
| structures | |
| Format of record | |
| relationships | |
| ===== | |
| a. Contents of physical | |
| Schema | |
| | Names of user view |
| | Names of records |
| | (aliases) |
| | Format of records |
| | Names(aliases) of |
| | fields |
| | Format of fields |
| | ===== |
| | b. Contents of user |
| | views |

Figure 4.3 Results of Physical Database Design

2. Inputs to Physical Database Design

The inputs to the physical database design are the outputs of the logical database design, the system requirements, and the preliminary design of programs. These were already described in the previous section.

3. Physical Database Design Process

This is produced by transforming the logical design into a physical design. The specific outputs vary from one DBMS to another. It is impossible to describe this process, other than very generally, without first discussing the

physical database design specific DBMS features. The next chapter will contain further discussion.

D. DATABASE MODELS

A database model is a vocabulary for describing the structure and processing of a database [Ref. 3]. Database models are an important database design tool. They can use both logical and physical database design much as flowcharts or pseudocode are used for program design. And database models are used to categorize DBMS products. This section, discusses the components of database models, the three commercial database models, and survey of six important models.

1. Components of Database Model

Database models have two major components. The Data Definition Language (DDL) is a vocabulary for defining the structure of the database. The DDL must include terms of defining records, fields, keys and relationships. Also, the DDL should provide a facility for expressing a variety of user views. Ideally, the model will also provide a method for expressing database constraints.

Data Manipulation Language (DML) is the second component of database model. The DML is a vocabulary for describing the processing of the database. Two types of DML exist. Procedural DML is a language for describing actions to be performed on the database. procedural DML obtains a desired result by specifying operations to be performed. For procedural DML, facilities are needed to define the data to be operated on and to express the actions to be taken. Both data items and relationships can be accessed or modified.

Nonprocedural DML is a language for describing the data that is wanted without describing how to obtain it. The

user simply states what is wanted, not how to get the results. The DBMS is given the job of determining how to get the result. Nonprocedural DML is descriptive, not prescriptive.

2. Three Commercial Database Models

Database systems can be conveniently categorized according to several approach. The best know approaches are the relational, the hierarchical, and the network approach models. These have been used in the great bulk of database systems.

A model is hierarchical if its only data structure is a hierarchy (tree). With this model, all networks must first be decomposed to trees before they can be represented. And data are represented as a set of nested one-to-many and one-to-one relationships. This model is a special case of network model. So, many-to-many relationships are not directly supported and there is data redundancy.

A model is network if its data structures are both trees and simple networks. This model represents data as a set of record types and pairwise relationships between record types. Only complex networks need to be decomposed before they are represented.

The distinction between these two models has become unimportant. The hierarchical data model has become too narrow and the network data model too broad [Ref. 3]. The relational model will be described next section.

3. Overview of Prominent Database Models for Design

Figure 4.4 portrays six common and useful database models. The models are arranged on a continuum. Models on the left-hand side of this figure tend to be oriented to humans and human meaning, whereas those on the right-hand side are more oriented toward machines and machine specifications [Ref. 3].

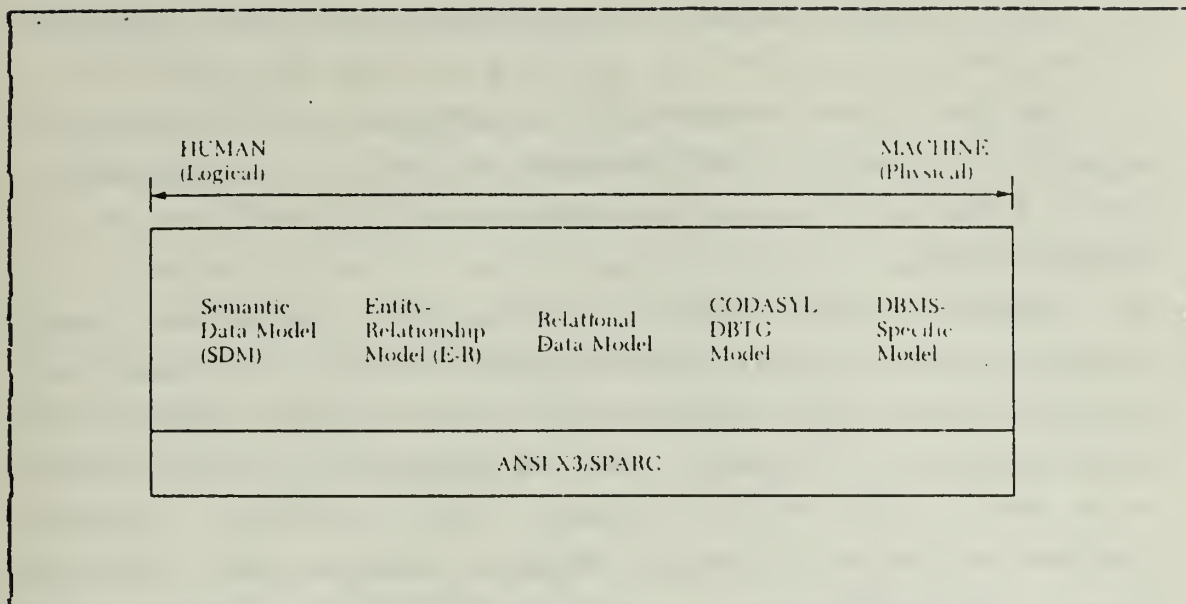


Figure 4.4 Relationship of Six Important Data Models

a. Relational data model --- The relational database model is near the midpoint of the human/machine continuum in figure 4.4, because it has both logical and physical characteristics. The relational model is logical in that data are represented in a format familiar to humans; the relational model is unconcerned with how the data are represented in computer files. On the other hand, this is more physical than SDM (semantic data model) or the E_R (entity relationship) model. Database that have been designed according to the relational need not be transformed into some other format before implementation. Thus the relational model can be used for both logical and physical database design.

A relation is simply a flat file. The rows of the relation are the file records. Rows are sometimes called tuples of the relation. The field of the relation (in the columns) are sometimes called the attributes of the relation. The significance of the relational model is not

that data are arranged in relations but that relationships are concerned to be implied by data values.

The principle advantage of carrying relationships in data is flexibility. Relationships need not be predefined [Ref. 2,3,4]. Further discussion of this will be in the next chapter.

b. Semantic data model --- The word semantic means meaning. The semantic data model provides a vocabulary for expressing the meaning as well as the structure of database data. As such, SDM is useful for logical database design and documentation. SDM provides a precise documentation and communication medium for database users. In particular, a new user of a large and complex database should find its SDM schema of use in determining what information is contained in the database. Also, SDM provides the basis for a variety of high level semantics-based user interfaces to a database.

SDM has been designed to satisfy a number of criteria that are not met by contemporary database models. The chief advantage of SDM is that it provides a facility for expressing meaning about the data in the database.

Another advantage of SDM is that it allows data to be described in context. Users see data from different perspectives. They see it relative to their field of operation. SDM allows relative data definition.

A third advantage of SDM is that constraints on database data can be defined. For example, if a given item is not changeable, SDM allows this fact to be stated. With other data models, such constraints are not part of the schema description and are documented separately.

SDM is like pseudocode, but instead of describing the structure of programs as pseudocode does, SDM describes the structure of data. Like pseudocode, SDM has certain structures and rules, and within those structures and

rules, the designer has a good deal of latitude and flexibility.

c. Entity - Relationship model --- The entity-relationship model(E-R model) is primarily a logical database model, although it has some aspects of a physical model as well. As its name implies, the E-R model is explicit about relationship. Unlike SDM, in the E-R model both entities and relationships are considered to be different constructs. Entities are grouped into entity sets, and relationships are grouped into relationship sets.

An entity-relationship diagram is a graphical portrayal of entities and their relationships. It is useful to summarize the information in a design. It supports the representation of more general relationships.

d. CODASYL DBTG model --- The CODASYL DBTG(Conference on Data System Languages, Database Task Group) data model was developed by the same group that formulated COBOL during the late 1960s and is the oldest of the data models. The DBTG model is a physical database model. There are constructs for defining physical characteristics of data, for describing where data should be located, for instructing the DBMS regarding what data structures to use for implementing record relationships, and other similar physical characteristics.

A DBTG schema is the collection of all records and relationships. A subschema is a subset and reordering of records and relationships in the schema. Unlike the relational model, relationships become fixed when they are defined in the schema.

Several reasons account for the lukewarm response that the CODASYL model has received, including the fact that it has a decidedly COBOL flavor to it. Finally,

although most of the core concepts of the model are defined and agreed upon, there are many not-agreed-on variants of the core concepts. These variants create confusion and lead to a dilemma.

e. DBMS-specific models --- There are over one hundred different commercial DBMS products. The DBMS are sometimes categorized in terms of their underlying data model. A DBMS is considered a relational system if it conforms, in essence, to the relational data model. Alternately, A DBMS is considered to be a CODASYL system if it conforms, in essence, to the CODASYL DBTG data model. A third category of DBMS is other. If a DBMS does not conform to one of the above two data models, then it has its own, unique data model. There are many systems that fall into the other category.

f. ANSI/X3/SPARC data model --- The ANSI/X3/SPARC (American National Standards Institute / Committee X3 / Standards Planning and Requirements (sub)-Committee) data model does support a variety of different data models in figure 4.4. This model is a model for DBMS design rather than for database design. This have the external, conceptual, and internal schema.

V. RELATIONAL DATABASE DESIGN

Database design is one of the most important steps in the development of computerized system. size and complexity combine to make this task disproportionately time consuming and expensive.

Developing a database is an evolutionary process with the objective being an "idealized database". This is information that contains all the necessary data about all facets of an organization's operations and from which can be extracted instantaneously, in any form desired, information in response to inquiries in any format.

There are many ways in which a database can be designed. Here, we will describe a design theory and application for 2nd Logistics Support Command.

The data processing center of the 2nd Logistics Support Command for the Korea Army logistics systems has the responsibility to analyze, develop and maintain the computer based logistics system modeling to support keeping of track all inventory of each echelon and supply system such as procurement for the army.

This thesis documents the construction of a sample computer based database system for logistics support system in order to keep track of all information and the inventory status of each item in each subordinate battalions which are Ordnance Battalion, Quarter-master Battalion, and Ammunition Battalion Figure 5.1.

Each Battalion has two units, so there are total six units. And each Battalion handles two items at least (actually more than hundred). The general background was already described in Chapter 2.

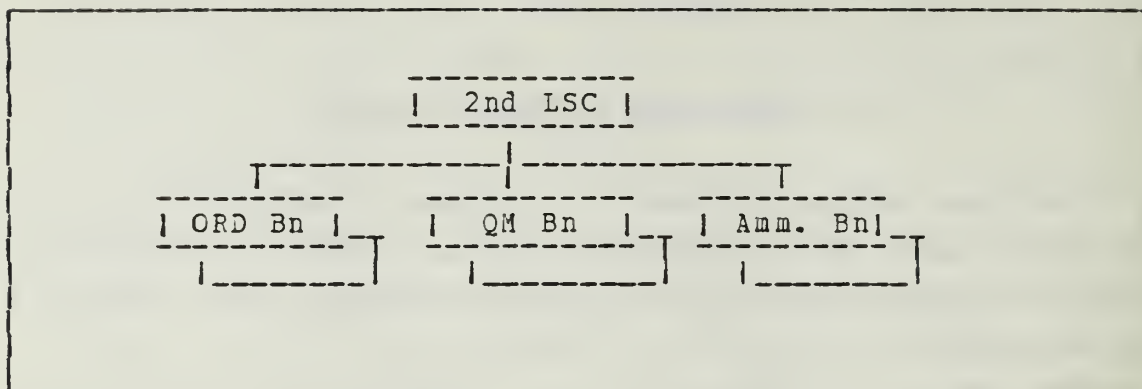


Figure 5.1 Organization of 2nd Logistics Support Command

A. STRUCTURE OF A RELATIONAL MODEL

1. Relations

The data structuring total used by the relational database model is a relation which is simply a two-dimensional table that has several properties. First, the entries in the table are single-valued; neither repeating groups nor arrays is allowed. Second, the entries in any column are all of the same kind. For example, one column may contain nomenclatures, and another unit-prices. Further, each column has a unique name and the order of the columns is immaterial. Columns of a relation are referred to as attributes. And no two rows in the table are identical and the order of the rows is significant. Figure 5.2 portrays a relation.

Each row of the relation is called a tuple. If the relation has n columns, then each row is referred to as an n -tuple. Also, a relation that has n columns or n attributes is said to be of degree n . The relation in figure 5.2 is of degree 4, and each row is a 4-tuple.

2. Domains and Attributes

Each attribute has a domain, which is the set of values that the attribute can have. That is, "M16A1RIFLE" is a value of attribute nomenclature. An attribute is the property of an entity which associates a value from a domain with each entity. The domain of stock number(SN) is all positive integers less than 999.

| | Col.1 | Col.2 | | |
|-------|------------------|-----------------|-------------------|-------------------|
| row 1 | STOCK- NUMBER | NOMENCLATURE | UNIT-OF -ISSUE | UNIT-OF -PRICE |
| row 2 | 100 | M16A1 Rifle | ea | 100.00 |
| : | 102 | 105m Motor | ea | 2000.00 |
| : | 105 | M16 Ammunition | box | 200.00 |
| : | 200 | 105m ammunition | box | 40.00 |
| : | 201 | MO - gas | dm | 220.00 |

Figure 5.2 Item Relation

A relation of degree n has n domains, not all of which need be unique. For example, consider age and age of spouse attributes, where the domains of the two attributes are the same, that is, they are integers from 1 to 100. To differentiate between attributes that have the same domain, each is given a unique attribute name, like age, spouse-age.

Figure 5.2 is an example, or occurrences. The generalized format, ITEM(SN, nomenclature, unit-of-issue, unit-price), is called the relation structure, and is what most people mean when they use the term "relation". If we add constraints on allowable data values to the relation structure, we have a relation schema [Ref. 3].

3. Keys

A key can be considered an attribute or a set of attributes which uniquely identify each entity in an entity set. It is necessary to be able to identify each tuple in a relation by values of its attributes. For example, the value{100, M16A1RIFLE, EA, 100.00} constitutes a unique identifier. It will be unique because duplicate tuples are not allowed. And attribute SN{100} of the ITEM relation has the property that each ITEM tuple contains a distinct SN value. This value may be used to distinguish that tuple from all others in the relation. SN is said to be the primary key for ITEM.

A relational schema will have more than one attribute or combination of attributes that are unique. For the relation figure 5.2, attributes SN and nomenclature may both be unique. If so, they are called "candidate keys". In the design of the database, one of them will be chosen as a primary key.

When an attribute in one relation is a key of another relation, the attribute is called a "foreign key". The term means that the attribute is a key, but in a foreign relation.

B. RELATIONAL DATA MANIPULATION

Having described the processing of relations in a general and intuitive manner. However, to process relations with a computer, it is necessary to present a clear, unambiguous language for manipulating the data. Four different strategies for relational data manipulation have been proposed [Ref. 1].

1. Categories of Relational DML

"Relational algebra", one of the strategies, defines operators that work on relations (akin to the operators +, -, etc., in high school algebra). Relations can be manipulated using these operators to achieve a desired result. Relational algebra is hard to use, partly because it is procedural.

Relational calculus is a second strategy for manipulating relations. Relational calculus is nonprocedural. It is language for expressing what we want without expressing how to get it. As integration in calculus has a variable, relational calculus has a similar variable. For "tuple relational calculus", the variable ranges over the tuples of a relation. For "domain relational calculus, the variable ranges over the values of a domain.

"Transform-oriented" languages are a class of nonprocedural languages that use relations to transform input data into desired outputs. These languages provide easy-to-use structures for expressing what is desired in terms of what is known. SQUARE, SEQUEL, and SQL are all transform-oriented languages.

The fourth category of relational DML is "graphic". Systems based on this technology provide the user with a picture of the structure of a relation. The user fills in an example of what is wanted, and the system responds with actual data in that format. Query-by-example(QBE) is an example of this process.

2. Relational Algebra

Here, only relational algebra is briefly described. Relational algebra is a far from the algebra operations like +, -, *, and / operated on numeric quantities. For relational algebra, the variables are relations, and the

operations manipulate relations to form new relations. For example, the operation $+$ (or union) combines the tuples of one relation with tuples of another relation. The result is a third relation [Ref. 1,5].

a. Union --- The union of two relations is formed by combining the tuples from one relation with those of a second relation to produce a third. Duplicate tuples are eliminated. For this operation to make sense, each relation must have the same number of attributes, and the attributes in corresponding columns must come from the same domain.

b. Difference --- The difference of two relations is a third relation containing tuples which occur in the first relation but not in the second.

c. Intersection --- The intersection of two relations is a third relation containing common tuples.

d. Product --- the product of two relations (sometimes called the cartesian product) is the concatenation of every tuple of one relation with every tuple of a second relation. The product of relation A (having m tuples) and relation B (having n tuples) has m times n tuples.

e. Project --- Projection is an operation that selects specified attributes from a relation. The result of projection is a new relation having the selected attributes. In other words, projection picks columns out of relation. Projection can also be used to change the other of attributes in a relation.

f. Selection --- Whereas the projection operator takes a vertical subset (columns) of a relation, the selection operator takes a horizontal subset (rows). Projection identifies attributes to be included in the new relation; selection identifies to be included in the new relation.

g. Join --- the join operation is a combination of the product, selection, and (possibly) projection operations. The join of two operations, say A and B, operates as follow: first, the product of A times B is formed. Then, selection is done to eliminate some tuples (the criteria for the selection are specified as part of the join). Then, (optionally) duplicate attributes are removed with projection.

C. SCHEMA DESIGN

A relational database is specified by a relational schema which consists of one or more relational subschemas. A relational subschema is a listing of a relation name and its corresponding attributes. Figure 5.3 represents an example of a relational schema for 2nd Logistics Support Command's database system.

```
ITEM ( SN, NM, UI, UP, OST, QTY, QTYOH, S:ID)
UNIT ( U:ID, U:NAME, PHONE, ADDR, ZIP)
```

Figure 5.3 An Example of a Relational Schema

1. Requirement Analysis

The first step of schema design is requirements analysis. This step consists of a high-level analysis of the function of an organization. The functions of the 2nd Logistics Support Command given in Chapter II are an example of requirements analysis. The purpose of this step is to

- a. gain familiarity with the area of the organization to be modeled
- b. determine the information requirements of the organization without regard to constraints other than the way in which the organization does business;
- c. represent these requirements via some formal modeling technique

The main purpose of requirements analysis is to understand the user's needs. Subsequent steps of the schema design process can transform these needs to subschemas according to the relational data model.

Information requirements are collected from users at all levels in the organization. From top management, information on the goals and objectives of the organization can be obtained, along with strategies and methods for managing the implementation of the strategies. Middle management provides data about required response time, reliability, security, and privacy, etc. Finally, operations management provides more specific information, such as names, sizes, number of occurrences, integrity constraints, reliability, security and privacy of data [Ref. 7].

2. Record Relationships

The essence of database is the representation of record relationships. The relationships can be specified in a variety of ways. Figure 5.4 shows one technique, called a data structure diagram, or DSD(also called a Bachman diagram). This method was used, because this is a simple methods to represent overall records structures. The single/double arrow notation is used to express relationships among records(one-to-one, one-to-many, many-to-many relationships). The DSD only shows the relationships among records.

The relationships are identified intuitively. The design team considers potential relationships among records

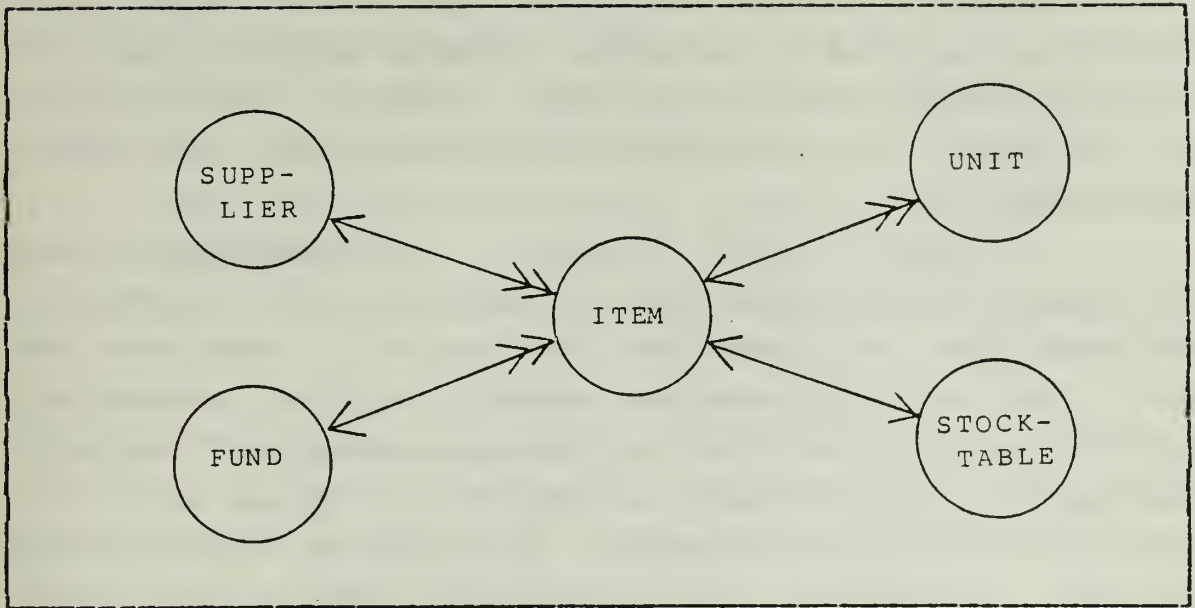


Figure 5.4 Bachman Diagram of 2nd Logistics Support Command

that have been defined. A relationships may exist among three or four or more records.

At this point the design team must discriminate between theoretical and useful relationships. A theoretical relationship can exist logically, but may never be needed in practice.

Figure 5.4 represents a situation wher one supplier supplies many items, and one item is supplied by only one supplier. One team could be handled by many units, and one unit have many items.

3. Record Atructure

In Appendix A, each record structure represents a view of the subschema/schema. This record structure shows a relation among attributes, key attribute which is underlined to identify each record and relation between record(entity) and attributes. Also full-name of attributes are described to identify each attribute.

Record structure is detailed-design of record relationship. A record is created, many-to-many relationship between records need another record which is called "intersection record" to match their relationship(e.g. IUQ record in Appendix A).

A trends toward integrated file structures has resulted in the grouping of all data elements relevant to the management and operations section of a user organization. The emerging database concept requires placing all relevant data in one database in a consistent and standardized manner, and providing selective inquiry and extraction capabilities designed to meet a wide variety of information requests. Therefore, record structure must be well aggregated and organized in order to achieve the goals of this system.

4. Data Dictionary

Management of a database is usually a complex process. It requires the database administrator to keep track of all the database and user view definitions as well as their use.

Data dictionaries have been developed to aid the database administrator in this task. The generation of the data dictionary which documents functions, data classes, allowable values, formats, and their interrelationship should be initiated at this point [Ref. 8].

Individual DBMS have their own methods for defining data descriptions. Each has a repository for the database description, a language facility to process that description, and a mechanism to input that description to the DBMS. A comprehensive dictionary will include cross-reference information such as which programs use which pieces of data, which departments require which reports, and so on. The general objectives of a data dictionary are to provide [Ref. 9].

- a. various reporting facilities such as cross-reference reports, changes effecting reports, error-reports, etc;
- b. various retrieval capabilities such as keywording, indexing, and online or batch querying;
- c. common language to control, retrieve and update the data dictionary;
- d. validation and redundancy - checking capabilities
- e. security safeguards to control access to the data dictionary
- f. data description generation

The examples of data dictionary for 2nd Logistics Support Command are shown on Appendix B.

D. RELATIONAL NORMAL FORMS

1. Anomalies

Some database design are better than others. A design that meets the user's needs is better than one that does not, but there are other criteria as well. Normal forms are (a) rules for assigning fields to files (relations) in a relational DBMS, (b) guidelines to prevent users from trying to place data together that does not belong together, (c) and are useful guides even if one is not using a DBMS.

With some relations changing data can have unexpected consequences. These consequences are called "modification" anomalies and are not desirable. When a fact is deleted, facts about two entities with one deletion are lost. This characteristic is called a "deletion anomaly" and is considered undesirable.

Also, when facts are gained about two entities with one insertion, a fact can not be inserted about one until we have an additional fact about another entity has been obtained. This characteristic is called an "insertion anomaly". These anomalies can be eliminated by creating two new relations via projection.

And, when a fact is updated, the changing of one fact requires the research for all tuples containing this facts. This character is called an "updating anomaly".

2. Normal Forms

There are seven kind of normal forms which are shown in figure 5.5 [Ref. 1]. Usually, third normal form can be a design goals.

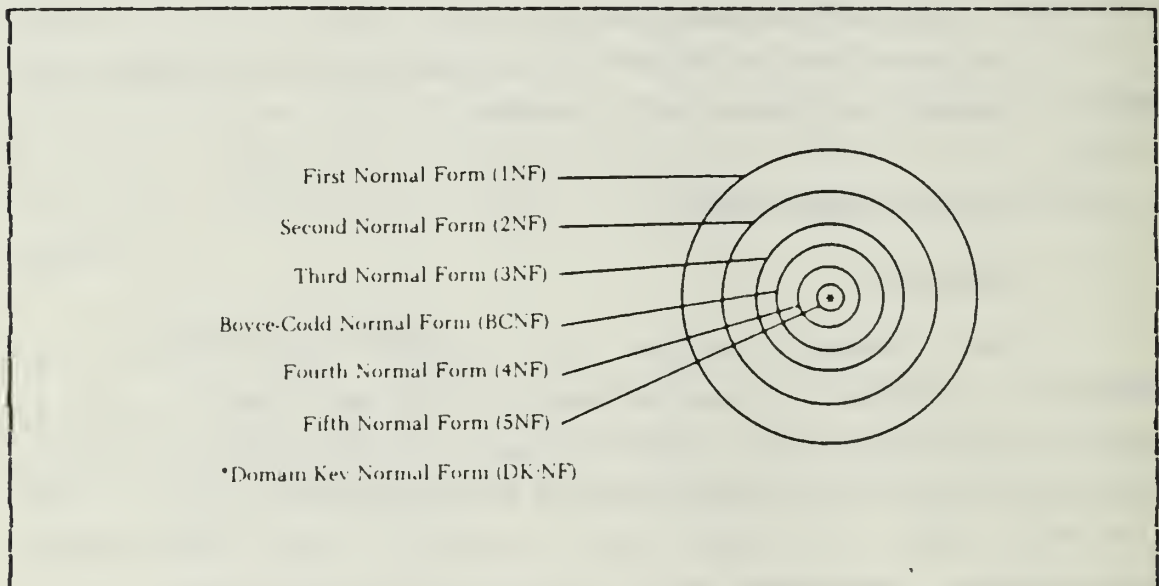


Figure 5.5 Relationship of Normal Forms

a. First normal form --- first normal form is the starting point: all relations are in first normal form. Relations in first normal form have modification anomalies. Some of these anomalies can be eliminated by putting the relation in second normal form. Second, third, and boyce-codd normal forms all address anomalies caused by inappropriate "functional dependencies".

A functional dependency is a relationship between attributes. Attribute Y is said to be functionally

dependent on attribute X if the value of X determines the value of Y. For example, suppose that the serial number of an item is known, the nomenclature of the item can be determined.

An attribute is a 'determinant' if it occurs on the left-hand side of a function dependency. Determinants may or may not be unique.

b. Second normal form --- The company relation in figure 5.6 has modification anomalies. If the tuple for SN 300 is deleted, the fact that DAE-WHA's item costs \$2500 is lost. Also, can not be entered a company until an item is procured.

The problem with this relation is that it has a dependency involving only part of the key. The key is the combination(SN, ccompany), but the relation contains a dependency, company --> price for an item. The modification anomalies could be eliminated if the nonkey attribute, price, were dependent on all of the key, not just part of it. This leads that a relation is in second normal form if all nonkey attributes are dependent on all of the key.

Company can be decomposed via projection to form two relations in second normal form. The relations to be formed are COMPANIES{SN,COMPANY}, and COMPANIES{COMPANY, PRICE}.

c. Third normal form --- Unfortunately, relations in second normal form also have anomalies. Consider the supplier relations in figure 5.7a. The key is SN, and the functional dependencies are SN --> COMPANY and COMPANY --> CITY. This means that a SN(item) supplied by only one company since company determines city. Since SN determines company and since company determines city, indirectly, SN --> CITY(the item is supplied in the city). Thus this relation is in second normal form(both city and company

| SN | COMPANY | PRICE |
|-----|------------|-------|
| 100 | Pung - san | 1000 |
| 100 | Dae - woo | 2000 |
| 200 | Dae - woo | 2000 |
| 200 | Remington | 3000 |
| 300 | Dae - wha | 2500 |

Figure 5.6 Relation with a Two-Attribute Key

are determined by SN). However, it has anomalies. If fourth tuple in the relation is deleted, not only is the fact lost that SN 400 is made by Remington, the fact that the Remington company is in Detroit is also lost.

So, second normal form is not enough. To eliminate these anomalies, the transitive dependencies($X \twoheadrightarrow Y$, $Y \twoheadrightarrow Z$) must be eliminated. This leads to a definition of third normal form: A relation is in third normal form if it is in second normal form and if it has no transitive dependencies.

The supplier relation can be divided by projection into two relations in third normal form. The relations SN-SUP(SN, company) and SUP-CITY(COMPANY, CITY) in Figure 5,7b are examples. Also Appendix A, also gives examples. Record structure show the third normal form of 2nd LSC relation.

d. Other normal form --- Also, even relations in third normal form can have anomalies. This situation leads to the definition of boyce-codd normal form(BCNF). A relation is in BCNF if every determinant is a candidate key which two or more attributes or attribute collections can be a

| SN-SUP (SN, COMPANY) | | SUP-CITY (COMPANY, CITY) | |
|----------------------|-----------|--------------------------|-----------|
| SN | COMPANY | COMPANY | CITY |
| 100 | Pung-San | Pung-San | Ma-San |
| 200 | Dae-Woo | Dae-Woo | Chang-Won |
| 300 | Dae-Woo | Remington | Detroit |
| 400 | Remington | | |
| 500 | Pung-San | | |

b. Relations Eliminating the Transitive Dependency

| SUPPLIER (SN, COMPANY, CITY) | | |
|------------------------------|------------|-------------|
| SN | COMPANY | CITY |
| 100 | Pung - San | Ma - San |
| 200 | Dae - Woo | Chang - Won |
| 300 | Dae - Woo | Chang - Won |
| 400 | Remington | Detroit |
| 500 | Pung - San | Ma - San |

a. Remington with Transitive Dependency

Figure 5.7 Elimination of Transitive Dependency

key. Relations in BCNF have no anomalies regarding functional dependencies, but anomalies can arise from situations other than functional dependencies.

Formally, multivalued dependency is defined as follows; in relation $R(X, Y, Z)$, $X \twoheadrightarrow Y$ if each X value is associated with a set of y values in a way that does not depend on the Z values.

A relation is fourth normal form if it is in BCNF and has no multivalued dependencies, or if it is in BCNF and all multivalued dependencies are also function dependencies. This means that if a relation has multivalued dependencies and it is in fourth normal form, then the multivalued dependencies have a single value.

A relation is in fifth normal form if and only if every join dependency in relation is implied by the candidate keys of the relation.

A relation is in domain/key normal form if every constraint on the relation is a logical consequence of the definition of keys and domains. A constraint is any rule on static values of attributes that is precise enough that it can be evaluated. DK/NF means that if one can find a way to define keys and domains such that all constraints will be satisfied when the key and domain definitions are satisfied, then modification anomalies are impossible. If one can put a relation in DK/NF, then it is guaranteed that there be no anomalies. But there is no way to convert a relation to DK/NF automatically, nor is it even known which relations can be converted to DK/NF.

E. RELATIONAL DATABASE DESIGN CRITERIA

There are several different kind of criteria for producing an effective relational database design. Barri and co-workers have identified three relational criteria [Ref. 10].

- * Representation : The final structure must correctly represent the original specification.
- * Specification : The original specification are divided into relations that specify certain conditions.
- * Redundancy : The final structure must not contain any redundant information.

Also, D. Kroenke has provided the three following design criteria which are elimination of modification anomalies, relation independence, and ease of use [Ref. 1].

1. Elimination of modification anomalies : If relations can be put into DK/NF, then no modification anomalies can occur. Thus DK/NF becomes a design objective, and relations that are in DK/NF are usually preferred.

Not all relations can be put into DK/NF, as described earlier. This occurs when there are constraints that cannot be expressed as logical consequences of keys and domains. An example described by Fagin [Ref. 10] is a relation having the following constraints; the relation must never have fewer than three tuples. There is no way to express this constraint in terms of domain and keys. Thus it has a modification anomaly. In fact, this strange relation has a deletion anomaly but no insertion anomaly.

When relations cannot be transformed into DK/NF, the constraint cannot be expressed in term of domains and keys must be inserted into application programs. This is undesirable because the constraint is hidden.

2. Relation independence : Two relations are independent if modifications can be made to one without regard for the other. The greater the independence, The better. However, independence is not always achievable. For example, interrelation constraints are a form of relation dependence. To eliminate this dependence, the relations can be joined together. The joined relation, however, may have modification anomalies.

Here the conflict in design goals is seen. To eliminate modification anomalies, relations are split; but in so doing, interrelation dependencies are created. In this case it is necessary to choose the least of the evils, based on the requirements of the application.

Projections that generate false data upon joining are called "loss projections". Projections that do not cause false data to be generated on joining are called "nonloss projections". If the projections do

not capture the essence of the functional dependencies, then it could be cause of loss projections.

3. Ease of use : A third criterion for a relational design is ease of use. as far as possible, we strive to structure the relations so that they are familiar and seen natural to users. Sometimes this goal conflicts with the elimination of anomalies or with independence.

VI. IMPLEMENTATION

A. RELATIONAL DATABASE MANAGEMENT SYSTEM

The relational model as the theoretical basis was introduced in the previous chapter. An important aspect of the theory is normal relations. Normal relations process many desirable structural properties. The criteria of normal relations are subsequently applied in data analysis to realize logical structures that satisfy normal relation properties.

This chapter describes the relational model as an implementation model that is supported by a DBMS. Any relations produced during data analysis can be implemented directly on the DBMS.

Because of its tabular interface, the relational model makes an attractive implementation model. It is receptive to two types of environment [Ref. 11]

1. the traditional data processing environment, where databases are set up by professional computer programmers on behalf of database users;
2. environments in which nonprogrammer users set up their own databases;

The relational model provides the same advantage in both types of environment. Its natural interface simplifies the design and use of the database. This is particularly so if a language with powerful selective capabilities can be provided by the DBMS. Such languages can reduce program development time and hence are attractive in commercial data-processing environments. They are also attractive to nonprogrammer users, allowing them to use the database without resorting to computer-oriented procedural languages.

However, there are problems in relational model implementations. A powerful language such as relational algebra or SQL is necessary to realize the full potential of a relational DBMS. These languages can be expensive to implement and use.

1. Relational Characteristics

What characteristics must a DBMS have to be considered a relational product? In his lecture, E.F. Codd [Ref. 12] defined a relational DBMS as one in which data is defined in tables and processed by using SELECT, PROJECT and unrestricted JOIN operations, or their equivalent. Codd called a system having these characteristics Minimally Relational [Ref. 1].

SELECT, PROJECT, and JOIN will be used in next section. The SELECT obtains rows of the table according to criteria on raw contents. PROJECT obtains columns of a table by column name. Finally, JOIN brings two relations together based on the relationship between two columns having the same domain.

Some DBMS products specify that only columns can be used as JOIN criteria. For examples, a DBMS may require the columns used as JOIN criteria to be indexed. This implies the undesirable situation of restricting user activity because of physical data representation. To the nonspecialist user, this restriction appears arbitrary. To eliminate this situation, Codd specifies that a minimally relational system must have unrestricted JOINS. This means that any column can be used as criteria for the join.

2. Commercial Relational DBMS

There are currently many commercial DBMS products that claim to be relational. Some are more relational in

name than in actuality. Criteria can be used to access whether or not a product is truly a relational product. Specifically, the DBMS should model data as tables, and it should support SELECT, PROJECT, and unrestricted JOIN operations.

Relational DBMS can be divided into three groups. One group is based on the data language SQL, one on the data language QUEL, and a third contains systems falling into neither of the other two categories [Ref. 1].

Three major SQL-based DBMS products are SQL/DS, system R, and ORACLE. System R is a research system developed by IBM for the study of relational technology. ORACLE is vended by Relational Software Incorporated. Originally, ORACLE was developed for operation on Digital Equipment Corporation PDP minicomputers. Since its origin, ORACLE has been converted to operate on IBM mainframes as well. ORACLE's user interface is based on SEQUEL II, an earlier version of SQL. According to RSI, ORACLE will soon be compatible with the current version of SQL. QUEL is a data language like SQL. (Just like COBOL and PL/I are alternative programming languages, SQL and QUEL are alternative data languages.) QUEL is based on tuple relational calculus. QUEL is nonprocedural and allows the user to process data without concern for physical data structures.

There are many other relational DBMS. Figure 6.1 lists some of the major systems as of late 1982. There is also a microcomputer relational product:--- dBASE II is used to implement 2nd LSC system is an example of a relational(or tabular) DBMS that restricts join operations. The join columns must be indexed.

SQL-Based Systems

SQL/DS, IBM

ORACLE, Relational Software, Inc.

System R, IBM

QUEL- Based Systems

INGRES, Relational Technology, Inc.

IDM 500, Britton-Lee, Inc.

Other Relational Systems

MRDS/LINUS, Honeywell

dBASE II, Ashton-Tate

NOMAD, National Computer Sharing Services

Figure 6.1 Relational DBMS Products and Vender

B. IMPLEMENTATION USING DBASE II

The 2nd Logistics Support Command System has been implemented using dBASE II relational DBMS. As a word processor allows one to manipulate characters, words, sentences and pages to create a document that fits one's needs, dBASE II allows one to work with fields, records, and files to manage data in just the desired manner

To provide the necessary power, dBASE II provides many data management facilities. Among these are an interactive query language, a report writer to create tabular reports, and a powerful programming language that allows a knowledgeable person to adapt dBASE II to the needs of those who are less familiar with computers.

The basic operations necessary to implement and understand the 2nd LSC System in Appendices are given. If a more detailed explanation is desired, reference to dBASE II user's guide is recommended [Ref. 13,14].

First, to create a file, CREATE command is used.

```
. CREATE
ENTER FILENAME: ITEM
ENTER RECORD STRUCTURE AS FOLLOWS:
  FIELD  NAME,TYPE,WITH,DECIMAL PLACES
  001    SN,C,3
  002    NOMENCLATURE,C,10
  003    QUANTITY,C,10
  004    <CR>
INPUT DATA NOW? N
```

A file called ITEM.DBF has now been created on the disk.
To select a file to work with by giving the command USE

```
. USE ITEM
```

To add the information to the file, use the APPEND command. APPEND lets the user move the cursor to any field, and enter or change the information.

```
. APPEND
```

```
RECORD 00001
```

```
SN           : 423
```

```
NCMENCLATURE: M16A1RIFLE
```

```
QUANTITY     : 222
```

```
RECORD 00002
```

```
SN           : 234
```

```
NOMENCLATURE: 105MOTOR
```

```
QUANTITY     : 150
```

```
RECORD 00003
```

```
SN           : <CR>
```

Now necessary information has been added. To list a data file's contents on the screen, LIST command is used.

```
. LIST
```

```
00001  423  M16A1RIFLE  222
```

```
00002  234  105MOTOR    150
```

```
. LIST FOR SN = "423"
```

```
00001  423  M16A1RIFLE  222
```

To sort a data file

```
. SORT ON SN TO NEWSN
SORT COMPLETE
. USE NEWSN
. LIST SN,NOMENCLATURE

00001  234 105MOTOR
00002  423  M16A1RIFLE
```

NEWSN is given as new file name for sorted file. If a specific item, and not the whole list, is wanted, then the FIND command can be used to display on the screen.

```
. FIND 105MOTOR
. DISPLAY

00001  234 105MOTOR 150
```


dBASE . II has a useful command REPORT. Designing a REPORT is similar to CREATEing a data file. The report can include totals of numeric field.

```
.USE ITEM
.REPORT FROM NEWSN
ENTER OPTIONS,  M=LEFT MARGIN,  L=lines/PAGE,  W=PAGE
WIDTH
PAGE OPTIONS? (Y/N) Y
ENTER PAGE HEADING: EQUIPMENT STATUS REPORT
DOUBLE SPACE REPORT? (Y/N) N
ARE TOTAL REQUIRED? (Y/N) N
CCL          WIDTH, CONTENTS
001          3, SN
ENTER HEADING: SN
002          10, NOMENCLATURE
ENTER HEADING: NCMENCLATURE
003          10, QUANTITY
ENTER HEADING: QUANTITY
004  <CR>
```

This REPORT specification is the saved on the disk as NEWSN.FRM. It may be printed at any time by repeating the REPORT command.

.REPORT FROM NEWSN

PAGE NO. 00001

3/10/85

EQUIPMENT STATUS REPORT

| SN | NOMENCLATURE | QUANTITY |
|-----|--------------|----------|
| 234 | 105MOTOR | 150 |
| 423 | M16A1RIFLE | 222 |

. REPORT FROM NEWSN FOR SN="423"

PAGE NO. 00001

3/10/85

EQUIPMENT STATUS REPORT

| SN | NOMENCLATURE | QUANTITY |
|-----|--------------|----------|
| 423 | M16A1RIFLE | 222 |

If the contents of data file is changed, the EDIT command can be used. EDIT allows full screen operation.

. LIST

| | | | |
|-------|-----|------------|-----|
| 00001 | 423 | N16A1RIFLE | 222 |
| 00002 | 234 | 105MOTOR | 150 |

. EDIT 2

RECORD 00002

SN :234

NCMENCLATURE :155MOTOR

QUANTITY :140

. LIST

| | | | |
|-------|-----|------------|-----|
| 00001 | 423 | M16A1RIFLE | 222 |
| 00002 | 234 | 155MOTOR | 140 |

To delete records from a data file

. USE ITEM

. LIST

| | | | |
|-------|-----|------------|-----|
| 00001 | 423 | M16A1RIFLE | 222 |
| 00002 | 234 | 155MOTOR | 140 |

. 1

. DELETE

00001 DELETION (S)

. DISPLAY

| | | | |
|-------|------|------------|-----|
| 00001 | *423 | M16A1RIFLE | 222 |
|-------|------|------------|-----|

The record is still in the file, and has been marked with an asterisk for deletion later. dBASE II follows the safe method of removing records. They are first marked with the DELETE command, and then removed with the PACK command. This way it is possible to reconsider RECALL the record before packing it.

```
. RECALL
00001 RECALL(S)

.DISPLAY
00001      423      M16A1RIFLE      222

. COPY TO TEST1
. USE TEST1
. 1
. DELETE
00001  DELETION(S)
. PACK
PACK COMPLETE, 00002 RECORD COPIED

. LIST
00001  234      155MOTOR      140
```


When it is necessary to know the internal structure of a data file, the command LIST STRUCTURE which displays this information can be used.

. LIST STRUCTURE

STRUCTURE FOR FILE: ITEM.DBF

NUMBER OF RECORDS: 00002

DATE OF LAST UPDATE: 3/10/85

PRIMARY USE DATABASE

| FLD | NAME | TYPE | WIDTH | DEC |
|-------------|--------------|------|-------|-----|
| 001 | SN | C | 003 | |
| 002 | NOMENCLATURE | C | 010 | |
| 003 | QUANTITY | N | 010 | |
| ** TOTAL ** | | | 00023 | |

To use more than one data file, dBASE II reserves two areas of memory for data file. If it is necessary to use another data file at the same time. SELECT SECONDARY must be used while work is being done in the PRIMARY area of memory. This will open the other area of memory. SELECT PRIMARY moves the user back to the PRIMARY area.

```
. SELECT PRIMARY
```

```
. USE ITEM
```

```
. LIST
```

```
00001    423          M16A1RIFLE      222
```

```
00002    234          155MOTOR        140
```

```
. SELECT SECONDARY
```

```
. USE NEWSN
```

```
. LIST NOMENCLATURE
```

```
00001    NOMENCLATURE
```

```
00002    M16A1RIFLE
```

```
. SELECT PRIMARY
```

VII. CONCLUSION

This thesis has focused on the Korean Army 2nd Logistics Support systems and inventory status. However its findings are applicable to all departments of the Korean military logistics support system.

The developed sample database presented here is based on a relational database model and a computerized six logistics support battalions of 2nd LSC for logistics personnel, and it may very well form the basis of the total Korean Army management system.

The army logistics system is very complex and deals with about 200 thousand items. To manually manage all army logistics system is a very tedious, time consuming job and would not prove effective to increase war power. Thus, the Army needs a computerized logistic management system

Database processing can increase end-user productivity, decrease staff, enable work to be done more efficiently, provide information effectively and timely, and increase combat capability.

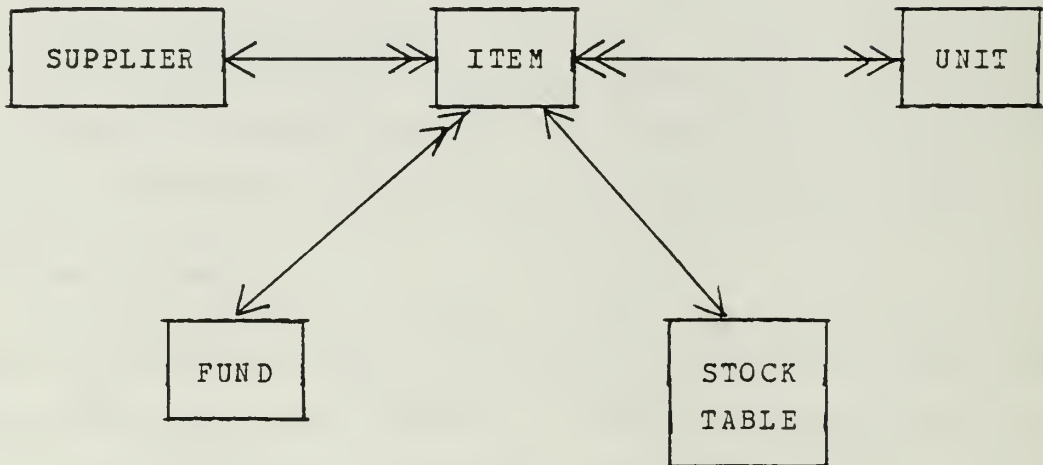
A database is the interface between people and machines. Database design is a two-phased process. This thesis examined both logical and physical database design process, and this process is an iterative process to get closer to an acceptable and optimal design. Normal forms can be applied to decrease inefficiency of the relational database model in the system-design process.

Implementation of a sample database using dBASE II resulted in a more effective and timely presentation of all required logistics information. This DBMS in Appendix is developed for end-users who are working in the ROK Army 2nd LSC who do not have experience with database systems or computers.

This database can serve as a prototype for ROK Army database management systems. The question, What type of DBMS should be installed for each unit level of mainframe? is for further research.

APPENDIX A
RELATIONSHIPS AND RECORD STRUCTURE

1. RELATIONSHIP DIAGRAM



2. RECORD STRUCTURE

ITEM (SN,NM,UI,UP,OST,QTYOH,S:ID)

--

SN -- stock number

NM -- nomenclature

UI -- unit of issue

UP -- unit price

OST -- order shipping time

QTYCH -- quantity on hand

S:ID -- supplier identification

UNIT (U:ID,U:NAME,PHONE,ADDR,CITY,ZIP)

U:ID -- unit identification

U:NAME -- unit name

PHCNE -- phone number

ADDR -- address of unit

CITY -- name of city ZIP -- ZIP code

SUPPLIER(S:ID,COUNTRY,COMPANY,LOC,PHONE)

S:ID -- supplier identification

COUNTRY -- supplier country

COMPANY -- supplier company

LOC -- location of company

PHONE -- phone number

FUND(F:ID,F:SOURCE)

F:ID -- fund identification

F:SOURCE -- fund source

STOCKTABLE(SN,REQOBJ,SAFLVL,RDRPNT)

--

SN -- stock number

REQOBJ -- request objective quantity

SAFLVL -- safety stock level

RDRPNT -- reorder point

IUQ(SN,U:ID,QTY) ----- intersection record

-- -----

SN -- stock number

U:ID -- unit identification

QTY -- quantity on hand of each item by each unit

APPENDIX B
DATA DICTIONARY

ITEM FILE -----

VARIABLE NAME: SN
FORMAT: ALPHANUMERIC
WIDTH: 15
ALLOWABLE VALUE: SELECTED ITEM, ALL ALPHANUMERIC
DESCRIPTION: STOCK NUMBER OF EVERY ITEM

VARIABLE NAME: NM
FORMAT: ALPHANUMERIC
WIDTH: 15
ALLOWABLE VALUE: ALL ALPHANUMERIC
DESCRIPTION: NAME OF THE ITEM

VARIABLE NAME: UI
FORMAT: CHARACTER
WIDTH: 2
ALLOWABLE VALUE: "EA", "BX"
DESCRIPTION: THIS IS UNIT OF ISSUE, TWO VALUES ARE ALL

VARIABLE NAME: UP
FORMAT: NUMERIC
WIDTH: 10
DECIMAL: 2
ALLOWABLE VALUE: ALL NUMBERS
DESCRIPTION: UNIT PRICE, REPRESENTING UNIT IS "DOLLAR"

VARIABLE NAME: CST
FORMAT: ALPHANUMERIC
WIDTH: 2
ALLOWABLE VALUE: ALPHANUMERIC, NUMBER OF DAY
DESCRIPTION: HOW LONG IT WILL TAKE AFTER ORDER

VARIABLE NAME: QTYOH

FORMAT: NUMERIC

WIDTH: 10

ALLOWABLE VALUE: ALL NUMERIC, NUMBERS OF ITEM ON HAND
DESCRIPTION: THIS WILL REPRESENT QUANTITY OF ON HAND
BY ITEM.

VARIABLE NAME: S:ID

FORMAT: CHARACTER

WIDTH: 10

ALLOWABLE VALUE: SELECTED SUPPLIER'S INDIVIDUAL UNIQUE
NAME

DESCRIPTION: IDENTIFICATION OF SUPPLIER CODE

UNIT FILE -----

VARIABLE NAME: U:ID

FORMAT: ALPHANUMERIC

WIDTH: 4

ALLOWABLE VALUE: ONLY FOUR DIGITS

DESCRIPTION: USED FOR SECRET TO THE UNIT NAME
MUST BE UNIQUE

VARIABLE NAME: U:NAME

FORMAT: ALPHANUMERIC

WIDTH: 5

ALLOWABLE VALUE: SELECTED UNIT NAME "99XXX"

DESCRIPTION: TO IDENTIFY UNIT SIZE and FUNCTIONS

VARIABLE NAME: PHONE

FORMAT: ALPHANUMERIC

WIDTH: 15

ALLOWABLE VALUE: ALL TELE PHONE NUMBER. DIGIT and "-"
DESCRIPTION: EACH UNIT'S TELEPHONE NUMBER

VARIABLE NAME: ADDR

FORMAT: ALPHANUMERIC

WIDTH: 22

ALLOWABLE VALUE: ALL ALPHANUMERIC
DESCRIPTION: THE ADDRESS OF EACH UNIT

VARIABLE NAME: CITY

FORMAT: CHARACTER

WIDTH: 10

ALLOWABLE VALUE: ALL CITY'S NAME

DESCRIPTION: CITY NAME WHERE UNIT IS LOCATED

VARIABLE NAME: ZIP

FORMAT: ALPHANUMERIC

WIDTH: 5

ALLOWABLE VALUE: ONLY DIGIT

DESCRIPTION: REPRESENT OF LOCATION BY DIGIT

SUPPLIER FILE -----

VARIABLE NAME: S:ID * THE SAME IN THE ITEM FILE

VARIABLE NAME: CCOUNTRY

FORMAT: ALPHANUMERIC

WIDTH: 12

ALLOWABLE VALUE: ALL COUNTRY'S COMMON NAME

DESCRIPTION: THE COUNTRY NAME WHICH ITEM WAS MADE

VARIABLE NAME: CCOMPANY

FORMAT: CHARACTER

WIDTH: 15

ALLOWABLE VALUE: ALL COMPANY NAME WHICH ABSTRACTED

DESCRIPTION: TO IDENTIFY THE COMPANY WHICH MADE THE
ITEM

VARIABLE NAME: LCC

FORMAT: CHARACTER

WIDTH: 15

ALLOWABLE VALUE: NAME OF AREA

DESCRIPTION: THIS IS TO KNOW EASILY THE LOCATION OF
COMPANY FOR EVERYBODY

VARIABLE NAME: PHONE
FORMAT: ALPHANUMERIC
WIDTH: 15
ALLOWABLE VALUE: ALL TELEPHONE NUMBER
DESCRIPTION: TELEPHONE NUMBER OF SUPPLIER

FUND FILE -----

VARIABLE NAME: F:ID
FORMAT: CHARACTER
WIDTH: 5
ALLOWABLE VALUE: ABSTRACTED FUND SOURCE NAME, UNIQUE
DESCRIPTION: REPRESENT SOURCE OF FUND IN ABSTRACTED
TYPE

VARIABLE NAME: F:SOURCE
FORMAT: CHARACTER
WIDTH: 10
ALLOWABLE VALUE: SOURCE OF FUND
DESCRIPTION: IDENTIFY THE SOURCE OF FUND BY FULL NAME

STOCKTABLE FILE -----

VARIABLE NAME: SN * THE SAME IN THE ITEM FILE

VARIABLE NAME: REQOBJ
FORMAT: ALPHANUMERIC
WIDTH: 10
ALLOWABLE VALUE: SELECTED LEVEL, ONLY DIGIT
DESCRIPTION: REPRESENT REQUIRED QUANTITY ON THE STOCK

VARIABLE NAME: SAFLVL
FORMAT: ALPHANUMERIC
WIDTH: 10
ALLOWABLE VALUE: SELECTED QUANTITY BY DIGIT
DESCRIPTION: REPRESENT SAFETY LEVEL OF ITEM BY UNIT

VARIABLE NAME: RDRPNT
FORMAT: ALPHANUMERIC
WIDTH: 10

ALLOWABLE VALUE: SELECTED QUANTITY OF ITEM. ONLY DIGIT
DESCRIPTION: THE POINT WHICH MUST ORDER IF BELOW THAN
THIS

IUQ FILE -----

VARIABLE NAME: SN * THE SAME IN THE ITEM FILE

VARIABLE NAME: U:ID * THE SAME IN THE UNIT FILE

VARIABLE NAME: QTY

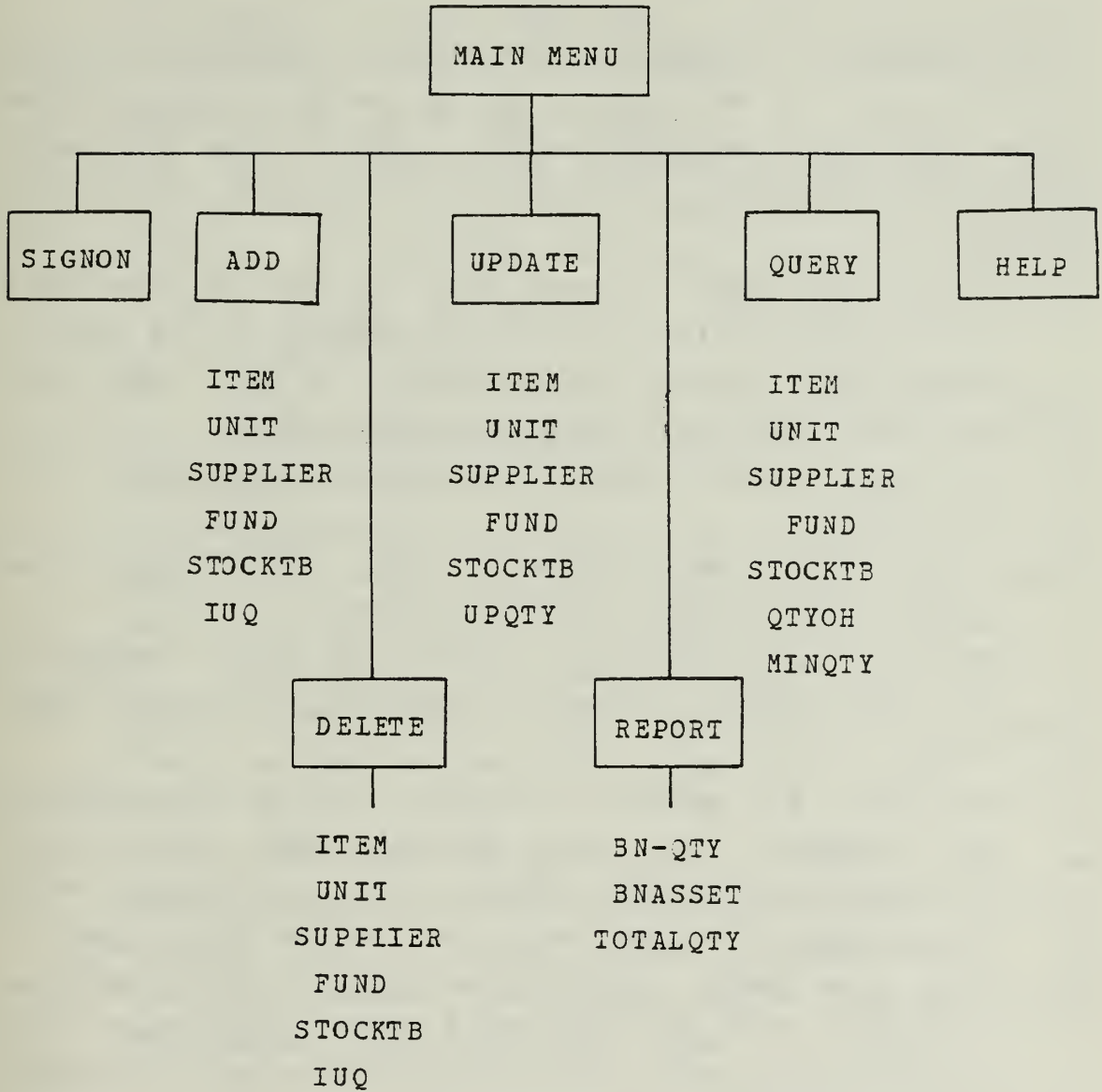
FORMAT: NUMERIC

WIDTH: 10

ALLOWABLE VALUE: QUANTITY OF EACH ITEM BY UNIT

DESCRIPTION: IDENTIFY QUANTITY OF EACH ITEM ON HAND

APPENDIX C
HIERARCHICAL CHART



APPENDIX D

USER MANUAL

This manual is to use the IBM personal computer. First, You have to set the machine, If the power turned off, then you need "Turn on" the power switch, and put the main chassis's switch (red color) to the "0" position, and then do the following

1. Insert the DBASE11 floppy disk in the disk slot that is on the left (You can see the letters on the disk)
2. insert the IS4183 class disk in to the right slot and close the drive slot by pushing down.
3. Now turn on the machine by locating the switch position "1".
4. Turn on the monitor (The T.V.set) by rotating the switch on its face from "0" to "1".
5. Turn on the printer by locating the switch either on the side or back of it and moving it to the "1" position.
6. Wait for the machine to prompt you for the date on the screen. You will see "CURRENT DATE IS TUE 1-01-1980 ENTER NEW DATE". Key the first month digit, next date and year. Then strike Return Key.
7. Then the system will give you the next message: "CURRENT TIME IS 0:00:15.65 ENTER THE TIME:" The same way with date, key the current "hour", "minute", and "second", then strike return key.
8. Then you will see the letter "A>". Now you are ready to start up DBASE-II software. Type "DEASE" right after that letter, and then strike return key. There are some messages, and last of them Dot(.) will appear on the screen.

9. Type "SET DEFAULT TO B" and return key, then Dot will be appear again. Now you are ready to use the 2nd Logistics command database system.
10. Type "DO MAIN" and return key. The signon message will appear. If you ready then key the any character(this command are in the message). Then menu menu message will be on the screen.
11. You have to follow the command message which appear on the screen. If there is "waitting" word near the cusor on the screen do not need to strike return key. If not, strike the return key after put the selected menu or other words.
12. All kind of main function of this system are specified on the first message(main menu). Put the mian menu-number which you want, then tere will be another message for menu on the screen. Select menu-number which you want and follow the command message on the screen. This system is menu type.
13. All done which you wanted, you can stop by selecting menu "0". Also you can stop by keying "Esc" on the keyboard and type "QUIT"(start after Dot).
14. If you are familiar with this system, you can directly (do not use main menu and menu program) execute which your wanted procedure by the fcllowing command: "DO PROGRAM NAME". But if you are not famliar with, don't try this!

APPENDIX E
RECORD FORMAT

*****ITEM.FMT 12/8/84*****

*AUTHER : W.D. SONG

*PURPOSE : This program will format for item file.

*CALLED BY : ADD,UPDATE

*PROGRAM CALL : NONE

*LOCAL VARIABLE : NCNE

*FILES USED : ITEM.IBF

@ 1,0 SAY"ENTER THE SN " GET SN PICTURE "!!!!!!!!!!!!!!!"

@ 2,0 SAY"ENTER THE NM " GET NM PICTURE "!!!!!!!!!!!!!!!"

@ 3,0 SAY"ENTER THE UI " GET UI PICTURE "!!"

@ 4,0 SAY"ENTER THE UP " GET UP PICTURE "99999999.99"

@ 5,0 SAY"ENTER THE CST" GET OST PICTURE "!!"

@ 6,0 SAY"ENTER THE QTYOH " GET QTYOH PICTURE "9999999999"

@ 7,0 SAY"ENTER THE SUPPLIER ID"GET S:ID PICTURE

"!!!!!!!!!!!!!!!"

*****UNIT.FMT 12/7/84*****

*AUTHOR:W.D.SONG

*PURPOSE: This program will format for unit file.

*CALLED BY:ADD,UPDATE

*PROGARMS CALL:

*LOCAL VARIABLE:

*FILES USED: UINT.DBF

*to clear the screen

@ 1,0 SAY"ENTER THE UNIT ID" GET U:ID PICTURE "!!!!!"

@ 2,0 SAY"ENTER THE UNIT NAME" GET U:NAME PICTURE "!!!!!"

@ 3,0 SAY"ENTER THE PHONE NUMBER" GET PHONE PICTURE

"!!!!!!!!!!!!!!!"

@ 4,0 SAY"ENTER THE ADDRESS" GET ADDR PICTURE

"!!!!!!!!!!!!!!!!!!!!!!"

@ 5,0 SAY"ENTER THE CITY" GET CITY PICTURE "!!!!!!!!!!!"

@ 6,0 SAY"ENTER THE ZIP CODE" GET ZIP PICTURE"!!!!!"

*****SUPPLIER.FMT 12/7/84*****

*AUTHOR:W.D.SONG

*PURPOSE: This program will format supplier file.

*CALLED BY:ADD.UPDATE

*PROGRAMS CALL:

*LOCAL VARIABLE:

*FILES USED: SUPPLIER.DBF

@ 1,0 SAY "ENTER THE SUPPLIER ID" GET S:ID PICTURE
"!!!!!!!!!!!!!!"

@ 2,0 SAY "ENTER THE COUNTRY" GET COUNTRY PICTURE
"!!!!!!!!!!!!!!"

@ 3,0 SAY "ENTER THE COMPANY" GET COMPANY PICTURE
"!!!!!!!!!!!!!!"

@ 4,0 SAY "ENTER THE LOCATION" GET LOC PICTURE
"!!!!!!!!!!!!!!"

@ 5,0 SAY "ENTER THE PHONE NUMBER" GET PHONE PICTURE
"!!!!!!!!!!!!!!"

*****STOCKTABLE.FMT 12/8/84*****

*AUTHOR:H.Y.LEE

*PURPOSE:This program will provide to format the stock
table.

*CALLED BY:ADD.UPDATE

*PROGRAMS CALL:

*LOCAL VARIABLE:

*FILES USED:STOCKTABLE.DBF

@ 1,0 SAY "ENTER THE STOCK NUMBER" GET SN PICTURE
"!!!!!!!!!!!!!!"

@ 2,0 SAY "ENTER THE REQUEST OBJECTIVE" GET REQOBJ PICTURE
"!!!!!!!!!!!!!!"

```

@ 3,0 SAY "ENTER THE SAFETY LEVEL" GET SAFLVL PICTURE
      "!!!!!!!!!!!!"
@ 4,0 SAY "ENTER THE REODER POINT" GET RDRPNT PICTURE
      "!!!!!!!!!!!!"

```

*****IUQ.FMT 12/9/84*****

```

*AUTHOR:W.D.SONG
*PURPOSE: This program will provide to format the
*         intersection file of thestock number and unit
*         and also provide on hand quantity.

```

*CALLED BY: ADD,UPDATE

*PROGRAMS CALL:

*LOCAL VARIABLES:

*FILES USED: IUQ.DBF

```

@ 1,0 SAY "ENTER THE STOCK NUMBER" GET SN PICTURE
      "!!!!!!!!!!!!"

```

```

@ 2,0 SAY "ENTER THE UNIT ID" GET U:ID PICTURE "!!!!"

```

```

@ 3,0 SAY "ENTER THE QTY OFEACH ITEM BY UNIT" GET QTY
      PICTURE "9999999999"

```

*****FUND.FMT 12/8/84*****

*AUTHOR: H.Y.LEE

```

*PURPOSE: This program will provide to format the fund
          file.

```

*CALLED BY:ADD,UPDATE

*PROGRAMS CALL:

*LOCAL VARIABLE:

*FILES USED:FUND.DBF

```

@ 1.0 SAY "ENTER THE FUND ID" GET F:ID PICTURE "!!!!!"

```

```

@ 2,0 SAY "ENTER THE FUND SOURCE" GET F:SOURCE PICTURE
      "!!!!!!!!!!!!"

```

APPENDIX F DATA LIST

A>DBASE
SET DEFAULT TO B
. USE ITEM
. LIST

| | | | | | | | |
|-------|-----------------|----------------|----|---------|----|---------|----------|
| 00001 | 123456789123456 | M16A1RIFLE | EA | 111.22 | 14 | 3616666 | PUNG-SAN |
| 00002 | 123456789234567 | 105M-MOTOR | EA | 2222.00 | 21 | 180 | DAE-WOO |
| 00003 | 123456789456789 | M16AMMUNITION | BX | 205.66 | 14 | 2377777 | PUNG-SAN |
| 00004 | 123456789567891 | 105MAMMUNITION | BX | 40.40 | 21 | 172345 | RMT |
| 00005 | 123456789789123 | COMBAT-SHOSE | BX | 555.88 | 7 | 5700 | DAE-WHA |
| 00006 | 123456789912345 | MO-GAS | DM | 220.00 | 3 | 1764800 | KYUNG-IN |

USE UNIT
. LIST

| | | | | | | | | |
|-------|------|-------|------------|----------|----------|-----|------------|-------|
| 00001 | 1978 | 15ORD | 22-33-1234 | KYUNG-GI | YANG-JU | 232 | DUK-JUNG | 12312 |
| 00002 | 1258 | 20ORD | 12-33-1222 | KYUNG-GI | YANG-JU | 384 | IL-DONG | 12378 |
| 00003 | 5274 | 51AMM | 22-44-5454 | KYUNG-GI | AN-SUNG | 343 | AN-SUNG | 17734 |
| 00004 | 5334 | 55AMM | 12-12-2345 | KANG-WON | CHUL-WON | 377 | CHUL-WON | 64422 |
| 00005 | 8756 | 11QTR | 22-22-6666 | KYUNG-GI | YANG-JU | 778 | TAE-GAEWON | 12333 |
| 00006 | 8976 | 15QTR | 11-55-3456 | KANG-WON | WON-JU | 994 | WON-JU | 88834 |

USE SUPPLIER
. LIST

| | | | | | |
|-------|----------|--------|-----------------|-----------|--------------|
| 00001 | PUNG-SAN | KOREA | PUNG-SAN AMM-CO | MA-SAN | 22-66-2345 |
| 00002 | DAE-WOO | KOREA | DAE-WOO CORP. | CHANG-WON | 55-33-7865 |
| 00003 | RMT | U.S.A. | REMINGTON | DETROITE | 203-444-7777 |
| 00004 | DAE-WHA | KOREA | DAE-WHA CORP. | DAE-JEON | 44-77-7896 |
| 00005 | KYUNG-IN | KOREA | KYUNG-IN ENERGE | IN-CHUN | 23-45-3678 |

USE STOCKTAB
. LIST

| | | | | |
|-------|-----------------|---------|---------|---------|
| 00001 | 123456789123456 | 2000000 | 1000000 | 1200000 |
| 00002 | 123456789234567 | 100 | 50 | 70 |
| 00003 | 123456789456789 | 2000000 | 1000000 | 1200000 |
| 00004 | 123456789567891 | 200000 | 100000 | 120000 |
| 00005 | 123456789789123 | 3000 | 1500 | 2000 |
| 00006 | 123456789912345 | 1000000 | 500000 | 700000 |
| 00007 | 222222222222222 | 300 | 150 | 200 |

USE FUND
. LIST

| | | |
|-------|----|--------|
| 00001 | KI | R.O.K. |
| 00002 | FY | U.S.A. |

| USE IUQ | | | |
|---------|-----------------|------|---------|
| . LIST | | | |
| 00001 | 123456789123456 | 1978 | 1000000 |
| 00002 | 123456789123456 | 1258 | 1950000 |
| 00003 | 123456789234567 | 1978 | 100 |
| 00004 | 123456789234567 | 1258 | 80 |
| 00005 | 123456789456789 | 5274 | 777777 |
| 00006 | 123456789567891 | 5678 | 12345 |
| 00007 | 123456789567891 | 5334 | 160000 |
| 00008 | 123456789789123 | 8756 | 2800 |
| 00009 | 123456789789123 | 8976 | 2900 |
| 00010 | 123456789912345 | 8756 | 900000 |
| 00011 | 123456789912345 | 8976 | 864800 |

APPENDIX G
PROGRAM

*****MAIN.PRG 12/9/84*****

*AUTHOR: H. Y. LEE

*PURPOSE: This program is to display the entire menu for
* selecting major function by user.

*CALLED BY:none

*PROGRAMS CALL: SIGNCN,ADD,DELETE,UPDATE,QUERY,REPORT,HELP.

*LOCAL VARIABLE: MAJORMENU,MOREA,ANS

SET TALK OFF

* clear screen and display sign on message

ERASE

DO SIGNCN

* Set up a loop for the user to select which major
* function to be done.

STORE T TO MOREA

*to set a main loop

DO WHILE MOREA

@ 2,2

TEXT

These are major menu for the logistic database system.
And allows you to add,delete,update,query,report, and
and help. Please choose a number for the function
which you want to perform.

- 0 quit the operation.
- 1 add new item or any data.
- 2 delete any data.
- 3 update for transaction data.
- 4 query some information.
- 5 produce periodic reports.
- 6 need help.

```

ENDTEXT
ACCEPT "Please enter the selected number here "
      TO MAJORMENU
* call the selected case statement function.
DO CASE
    CASE MAJORMENU ="0"
        USE
        ERASE
        RELEASE ALL
        RETURN
    CASE MAJORMENU ="1"
        DO ADD
    CASE MAJORMENU ="2"
        DO DELETE
    CASE MAJORMENU ="3"
        DO UPDATE
    CASE MAJORMENU ="4"
        DO QUERY
    CASE MAJORMENU ="5"
        DO REPORT
    CASE MAJORMENU ="6"
        DO HELP
    OTHERWISE
        @ 10,5 SAY "Please, check the entered menu and"
        @ 11,5 SAY "If not 0---6 then try again"
ENDCASE
* Loop back again
ACCEPT "Do you want another menu (y/n) ? " TO ANS
IF ! (ANS) = "Y"
    STORE T TO MOREA
ELSE
    STORE F TO MOREA
ENDIF
ENDDC
QUIT

```

```

*****SIGNON.PRG  12/9/84*****
*AUTHOR: H. Y. LEE
*PURPOSE:This program is to display the system anouncement.
*CALLED BY: Main
*PROGRAMS CALL: none
*LOCAL VARIABLE: none
ERASE
?
?
?
?
?
?
?"          LOGISTICS SUPPORT SYSTEM"
?
?"          FOR 2nd LOGISTICS  SUPPORT COMMAND"
?
?
?
?
?
?
?
?
?
?
?
?
?
?"*****   press any key if you ready   *****"
?
SET CONSOLE OFF
WAIT
SET CONSOLE ON

```

```

*****ADD.PRGM 12/9/84*****
*AUTHOR:H. Y. LEE
*PURPOSE: This will add new records which the user want to
          the current file.
*CALLED BY:main.
*PROGRAMS CALL: additem,addunit,addsupplier,addfund,
                addstocktable,addiug,help.
*LOCALVARIABLE: addmenu.
*FILES USED: none
SET TALK OFF
*to clear the screen
ERASE
DO WHILE T
  @ 2,2
  TEXT
    This is the add menu. It permits you to add new
    records which youwant. Please enter the number
    of the function you wish to perform.

    0 quit
    1 add item record
    2 add unit record
    3 add supplier record
    4 add fund record
    5 add stock table record
    6 add item unit quantity record
    7 need help.

    Enter the selected number
  ENDTXT
  WAIT TO ADDMENU
  ?" "
  ?" "
*case statement to perform the user's choice.

```



```

DO CASE
    CASE ADDMENU = "0"
        USE
        ERASE
        RELEASE ALL
        RETURN
    CASE ADDMENU = "1"
        DO ADDITEM
    CASE ADDMENU = "2"
        DO ADDUNIT
    CASE ADDMENU = "3"
        DO ADDSUPPLIER
    CASE ADDMENU = "4"
        DO FUND
    CASE ADDMENU = "5"
        DO ADDST
    CASE ADDMENU = "6"
        DO ADDIUQ
    CASE ADDMENU = "7"
        DO HELP
    OTHERWISE
        @ 10,5 SAY "PLEASE CHECK YOUR CHOICE!"
ENDCASE
*loop back again

```

```

*****ADDITEM.PRG  12/9/84*****
*AUTHOR: H.Y.LEE
*PURPOSE: This program will add new item record to current
*          item file.
*CALLED BY: ADD
*PROGRAMS CALL: ITEM.FMT
*LOCAL VARIABLES: ANSW,OK.
*FILES USED: ITEM.DBF
USE ITEM

```

```

*set the loop
STORE T TO ANSW
DO WHILE ANSW
    APPEND BLANK
    STORE F TO OK
    DO WHILE .NOT. OK
        ERASE
        SET FORMAT TO ITEM.FMT
        READ
        SET FORMAT TO SCREEN
        @ 15,2 SAY "IS IT CORRECT?(Y/N)" GET OK
        READ
    ENDDO
    @ 18,2 SAY"Do you want to add another record(Y/N)?"
    GET ANSW
    READ
ENDDO
*to return to the called routine
USE
ERASE
RELEASE ALL
RETURN

```

```

*****ADDUNIT,PRG 12/5/84*****

```

```

*AUTHOR : H.Y.LEE

```

```

*PURPOSE : This program will add new UNIT record

```

```

*CALLED BY : ADD

```

```

*PROGRAMS CALL : UNIT.FMT

```

```

*FILES USED : UNIT.LBF

```

```

*LOCAL VARIABLES : ANSWER, OK.

```

```

SET TALK OFF

```

```

USE UNIT

```

```

STORE T TO ANSWER

```

```

DO WHILE ANSWER

```

```

APPEND BLANK
STORE F TO OK
DO WHILE .NOT. OK
    ERASE
    SET FORMAT TO UNIT
    READ
    SET FORMAT TO SCREEN
    @ 21,0 SAY "Is it correct (y/n)?" TO OK
    READ
ENDDO
@ 22,0 SAY "Do you want to add another record (y/n)?"
TO ANSWER
READ
ENDDC
USE
ERASE
RELEASE ALL
RETURN

```

```

*****ADDSUPPLIER.PRG 12/9/84*****
*AUTHOR: H.Y.LEE
*PURPOSE: This program will add new supplier record.
*CALLED BY: ADD.PRG
*PROGRAMS CALL: SUPPLIER.FMT
*LOCAL VARIABLES: ANSWER,OK
*FILES USED: SUPPLIER.DBF
SET TALK OFF
USE SUPPLIER
STORE T TO ANSWER
*SET LOCP TO ADD RECCRD
DO WHILE ANSWER
    APPEND BLANK
    STORE F TO OK
    DO WHILE .NOT. OK

```

```

SET FORMAT TO SUPPLIER.FMT
READ
SET FORMAT TO SCREEN
@ 15,2 SAY "Is it correct(y/n)?" GET OK
READ
ENDDO
@ 19,2 SAY "Do you want to add another record(Y/N)?"
GET ANSWER
READ
ENDDO
USE
ERASE
RELEASE ALL
RETURN

```

```

*****ADDFUND.PRG  12/7/84*****
*AUTHOR: H.Y.LEE
*PURPOSE: This program will add new fund record
*CALLED BY: ADD
*PROGRAMS CALL: FUND.FMT
*LOCAL VARIABLES: ANSWER.OK
*FILES USED: FUND.DBF
SET TALK OFF
USE FUND
*SET THE LOOP TO ADD
STORE T TO ANSWER
DO WHILE ANSWER
    APPEND BLANK
    STORE F TO OK
    DO WHILE .NOT. OK
        SET FORMAT TO FUND.FMT
        READ
        SET FORMAT TO SCREEN
        @ 14,2 SAY "Is it correct(y/n)?" GET OK
    
```

```

        READ
    ENDDO
    @ 19,2 SAY "Do you want to add another record(y/n) "
    GET ANSWER
    READ
ENDDC
USE
ERASE
RELEASE ALL
RETURN

```

```

*****ADDST.PRG  12/6/84*****
*AUTHOR: W.D.SONG
*PURPOSE: This program will add new stock table record.
*CALLED BY:ADD
*PROGRAMS CALL:ST.FMT
*LOCAL VARIABLE: ANSWER,OK
SET TALK OFF
USE STOCKTABLE
*set loop to add
STORE 1 TO ANSWER
DO WHILE ANSWER
    APPEND BLANK
    STORE F TO OK
    DO WHILE .NOT. OK
        SET FORMAT TO STOCKTABLE.FMT
        READ
        SET FORMAT TO SCREEN
        @ 15,2 SAY"Is it correct(y/n)?" GET  OK
        READ
    ENDDO
    @ 19,2 SAY "Do you want to add another(y/n)?"
    GET ANSWER
    READ

```


ENDDC
USE
ERASE
RELEASE ALL
RETURN

*****ADDIUQ.PRG 12/7/84*****

*AUTHOR:W.D.SONG

*PURPOSE: This program will add new item unit quantity
*record.

*CALLED BY: ADD

*PROGRAMS CALL: IUQ.FMT

*LOCAL VARIABLES: ANSWER,OK

*FILES USED: IUQ.DBF

SET TALK OFF

*set loop to add

STORE T TO ANSWER

DO WHILE ANSWER

 APPEND BLANK

 STORE F TO OK

 DO WHILE .NOT. OK

 SET FORMAT TO IUQ.FMT

 READ

 SET FORMAT TO SCREEN

 @ 15,2 SAY"Is it correct(y/n)?" GET OK

 READ

 ENDDO

 @ 19,2 SAY " Do you want to add another record(y/n)?"

 GET ANSWER

 READ

ENDDO

USE

ERASE

RELEASE ALL

RETURN

```
*****DELETE.PRG 12/9/84*****
*AUTHOR: H.Y.LEE
*PURPOSE: This program will delete records which the user
*          want.
*CALLED BY: MAIN.PRG
*PROGRAMS CALL:
*LOCAL VARIABLES: MORE1,MORE2,TEMP1,TEMP2,TEMP3
*FILES USED: ALL FILES
SET TALK OFF
*set the loop to perform DELETE
STORE T TO MORE1
DO WHILE MORE1
    ERASE
    @ 2,2 SAY "Which file do you want to delete?
        Select one!"
    @ 3,2 SAY "FILE NAME TO SELECT: ITEM,UNIT,SUPPLIER,FUND
        STOCKTABLE,IUQ"
    ACCEPT"Be careful spelling! and put here the selected
        name" TO TEMP1
    USE &TEMP1
    DISPLAY ALL
    *to choose the record number which want to delete.
    ?"which record do you want to delete? e.g. 11 "
    ACCEPT "Please put selected number here:" TO TEMP2
    GOTO VAL(TEMP2)
    DISPLAY
    STORE " " TO TEMP3
    @ 21,0 SAY"Are you sure to delete this record(y/n)"
        GET TEMP3
    READ
    IF !(TEMP3) = "Y"
        DELETE
```

```

ENDIF
*If the user need more to delete
STORE " " TO MORE2
@ 22,0 SAY"Do you want delete another ? (y/n) "
      GET MORE2

READ
  IF ! (MORE2) = "Y"
    STORE T TO MORE1
  ELSE
    STORE F TO MORE1
  ENDIF

ENDDO
PACK
USE
RELEASE ALL
ERASE
RETURN

*****UPDATE.PRG  12/9/84*****
*AUTHOR:H.Y.LEE
*PURPOSE: This program will update(change) each record
          with a new data.
*CALLED BY: MAIN.PRG
*PROGRAMS CALL:UPQTY.PRG
*LOCAL VARIABLE:TITIE,RNUM,ANSWER,MORE
*FILES USED: ALL FILES
SET TALK OFF
*set the loop to execute DELETE
STORE T TO MORE
DO WHILE MORE
  ERASE
  @ 2,2
  TEXT
    Which file do you want to update?

```

```

file name : ITEM, UNIT, SUPPLIER, FUND,
            STOCKTABLE,IUQ
    *Please be careful with spelling!
ENDTEXT
ACCEPT"PUT HERE THE SELECTED FILE NAME :" TO TITLE
*to clear screen
ERASE
USE &TITLE
DISPLAY ALL
ACCEPT "Put here RECORD NUMBER which you want to
        update:" TO RNUM
GOTO VAL(RNUM)
*to set up moderate file format to UPDATE(CHANGE)
the data.
    IF TITLE ="ITEM"
        SET FORMAT TO ITEM.FMT
    ENDIF
    IF TITLE ="UNIT"
        SET FORMAT TO UNIT.FMT
    ENDIF
    IF TITLE ="SUPPLIER"
        SET FORMAT TO SUPPLIER.FMT
    ENDIF
    IF TITLE = "FUND"
        SET FORMAT TO FUND.FMT
    ENDIF
    IF TITLE = "STOCKTABLE"
        SET FORMAT TO STOCKTABLE.FMT
    ENDIF
    IF TITLE ="IUQ"
        SET FORMAT TO IUQ.FMT
    ENDIF
READ
SET FORMAT TO SCREEN
ACCEPT  "Is this correct(y/n) :" TO ANSWER

```

```

* to update the quantity on hand
DO UPQTY
IF !(ANSWER) = "Y"
    STORE F TO MORE
ELSE
    STORE T TO MORE
ENDIF
ENDDO
ERASE
RELEASE ALL
RETURN

```

```

*****REPORT.PRGM 12/9/84*****

```

```

*AUTHOR:H.Y.LEE

```

```

*PURPOSE: This program will select report menu to produce.

```

```

*CALLED BY:MAIN.PRGM

```

```

*PROGRAMS CALL:BNQTY.PRGM, BNASSET.PRGM, TOTQTY.PRGM

```

```

*LOCAL VARIABLES:MORE, ANSWER, NEED

```

```

*FILES USED:none

```

```

SET TALK OFF

```

```

*CLEAR SCREEN

```

```

ERASE

```

```

STORE T TO MORE

```

```

DO WHILE MORE

```

```

    @ 2,2

```

```

    TEXT

```

```

    This is the menu to make reports. Please choose one.

```

```

        0  quit

```

```

        1  on hand quantity of item by each battalion

```

```

        2  status of asset of item by each battalion

```

```

        3  total quantity by each item

```

```

        4  need help

```

```

    ENDTXT

```

```

    ACCEPT "Enter your selection here:" TO ANSWER

```


* CASE statement to perform the selection

DC CASE

CASE ANSWER = "0"

USE

ERASE

RELEASE ALL

RETURN

CASE ANSWER = "1"

DO BNQTY

CASE ANSWER = "2"

DO BNASSET

CASE ANSWER = "3"

DO TOTQTY

OTHERWISE

@ 3,3 SAY "PLEASE CHECK YOUR CHOICE!"

ENDCASE

ACCEPT "Do you want another REPORT(Y/N)?" TO NEED

IF !(NEED) = "Y"

STORE T TC MORE

ELSE

STORE F TC MORE

ENDIF

*loop back again

ENDDO

ERASE

RELEASE ALL

RETURN

*****BNQTY.PRG 12/9/84*****

*AUTHOR:H.Y.LEE

*PURPOSE: This program will produce report which includes

* on hand quantity of item by each battalion.

*CALLED BY: REPORT.PRG

*PROGRAMS CALL:none

```

*LOCAL VARIABLE:TEMP1, TEMP2,PRINTER,RET,CONT
*FILES USED:ITEM.DBF, IUQ.DBF, UNIT.DBF
* set loop
STORE T TO RET
DO WHILE RET
    SET TALK OFF
    *to print or not
    ACCEPT "Do you want to print out (y/n)?" TO PRINTER
    IF !(PRINTER) = "Y"
        SET PRINT CN
    ENDIF
    ERASE
    *to make HEADING
    ?
    ?"          STATUS OF ITEM QUANTITY"
    ?"          ====="
    ?
    ?
    ?
    ?"UNIT STOCK-NUMBER NOMENCLATURE QUANTITY  UI"
    ?"-----"
*This routine will make the needed data
    USE IUQ
    SELECT SECONDARY
    USE UNIT
    JOIN TO TEMP1 FOR P.U:ID = S.U:ID  FIELD U:NAME,SN,QTY
    USE TEMP1
    SELECT SECONDARY
    USE ITEM
    JOIN TO TEMP2 FOR P.SN = S.SN  FIELD U:NAME,SN,NM,QTY
                                UP
    USE TEMP2
    LIST
*back to the called routine
    ACCEPT"    Do you want to return to called routine

```

```

                (y/n)?" TO CONT
    IF !(CONT) = "Y"
        STORE F TO RET
    ELSE
        STORE T TO RET
    ENDIF
    *to release printer
    SET PRINT OFF
ENDDO
    USE
    ERASE
    RELEASE ALL
    RETURN

```

*****BNASSET.PRG 12/6/84*****

*AUTHOR:W.D.SONG

*purpose:This will produce report which include ASSET of
each item by unit.

*CALLED BY: REPORT.PRG

*PROGRAMS CALL:

*LOCAL VARIABLE:MORE,TEMP1,TEMP2,ATOT,PRINTER,ANSWER

*FILES USED:UNIT.DBF, IUQ.DBF, ITEM.DBF

SET TALK OFF

*set the loop

STORE T TO MORE

DO WHILE MORE

 * set up print

 ACCEPT"Do you want to print(y/n)?" TO PRINTER

 IF !(PRINTER) = "Y"

 SET PRINT CN

 ENDIF

 ERASE

 * make heading

 ?

```

?"          ASSET STATUS OF ITEMS BY BATTALION"
?"          =====
?
?
?
?"UNIT  NOMENCLATURE  QUANTITY  UNIT-PRICE  SUB-TOTAL"
?"-----"
*next routine produce necessary column and make total price
USE IUQ
SELECT SECONDARY
USE UNIT
JOIN TO TEMP1 FOR P.U:ID = S.U:ID  FIELD U:NAME,SN,QTY
USE TEMP1
SELECT SECONDARY
USE ITEM
JOIN TO TEMP2 FOR P.SN = S.SN  FIELD U:NAME,SN,NM,QTY,UP
USE TEMP2
STORE 0 TO ATOT
  DO WHILE .NOT. EOF
    ? U:NAME,NM,QTY,UP,QTY*UP
    STORE ATOT+QTY*UP TO ATOT
    SKIP
  ENDDO
?"THE TOTAL ASSET IS:----->",ATOT
*query for continuing this report again or not
ACCEPT"Do you want to make again(y/n)?" TO ANSWER
IF !(ANSWER) = "Y"
  STORE T TO MORE
ELSE
  STORE F TO MORE
ENDIF
*to release printer
SET PRINT OFF
ENDDO
*the end of program

```

USE
ERASE
RELEASE ALL
RETURN

*****TOTQTY.PRG 12/8/84*****

*AUTHOR:W.D.SONG

*PURPOSE: This program will provide a report to user the
* total quantity on hand of each item.

*CALLED BY: REPORT.PRG

*PROGRAMS CALL:

*LOCAL VARIABLE:MORE,PRINTER,ANSWER

*FILES USED:ITEM.DBF

SET TALK OFF

*set loop

STORE T TO MORE

DO WHILE MORE

 * to make print

 ACCEPT "Do you want to print out (y/n)?" TO PRINTER

 IF !(PRINTER) = "Y"

 SET PRINT ON

 ENDIF

 * clean the screen

 ERASE

 *to make heading

 ?

 ?" THE STATUS OF QUANTITY ON HAND BY EACH ITEM"

 ?" =====

 ?

 ?

 ?

 ?" STOCK-NUMBER NOMENCLATURE UNIT-PRICE QUANTITY"

 ?"-----"

 *produce each data list by item which indexed by stock


```

*number
  USE ITEM
  INDEX ON SN TO ITEMSN
  USE ITEM INDEX ITEMSN
  LIST SN,NM,UP,QTYCH
*to return to the called routine
  ACCEPT "Do you want again(y/n)?" TO ANSWER
  IF !(ANSWER) = "Y"
    STORE T TO MORE
  ELSE
    STORE F TO MORE
  ENDIF
*to release the printer
  SET PRINT OFF
ENDDO
*the end of program
USE
ERASE
RELEASE
RETURN

```

*****QUERY.PRG 12/8/84*****

*AUTHOR: H.Y.LEE

*PURPOSE: provide the status of each file and requested
* by user.

*CALLED BY: MAIN.PRG

*PROGRAMS CALL: MINQTY.PRG

*LOCAL VARIABLES :MORE, ANSWER,QMENU

*FILES USED:ALL FILES

SET TALK OFF

*Set up a loop for the user to select query which the user
want.

STORE T TO MORE

DO WHILE MORE

ERASE

@ 2,2

TEXT

This is quiry menu which prepared for you in this systems.

0 quit

1 item list(stock-number, nomenclature, unit-issue,
unit-price,order-shipping-time, quantity-on-hand,
supplier-id)

2 unit(unitname, phone, address, city, zip)

3 supplier(country, company, location, phone)

4 fund(source of fund)

5 stock-table(request-objective, safety-level,
reorder-point)

6 quantity of item by each unit

7 the item list which on hand quantity is less
than reorder point

ENDTEXT

ACCEPT " Enter the selection here !:" TO QMENU

*Execute the selected query case function.

ERASE

DO CASE

CASE QMENU = "0"

USE

ERASE

RELEASE ALL

RETURN

CASE QMENU = "1"

USE ITEM

LIST

CASE QMENU = "2"

USE UNIT

LIST

CASE QMENU = "3"

USE SUPPLIER

```

        LIST
CASE QMENU = "4"
    USE FUND
    LIST
CASE QMENU = "5"
    USE STOCKTABLE
    LIST
CASE QMENU = "6"
    USE IUQ
    LIST
CASE QMENU = "7"
    DO MINQTY
OTHERWISE
    ?"Please check the selected number!"
ENDCASE
* to continue or not?
ACCEPT"Do you want to another query (y/n)?" TO ANSWER
    IF !(ANSWER) = "Y"
        STORE T TO MCRE
    ELSE
        STORE F TO MORE
    ENDIF
ENDDO
USE
ERASE
RELEASE ALL
RETURN

```

*****MINQTY.PRG 12/7/84*****

*AUTHOR:W.D.SONG

*PURPOSE: This program will produce the list of item which
 * on hand quantity is less than reorder point.

*CALLED BY: QUERY.PRG

*PROGRAMS CALL: none

```

*LOCAL VARIABLE: WHEN,TEMP1,TEMP2,ANSWER,PRINTER
*FILES USED: IUQ.DBF, STOCKTABLE.DBF, ITEM.DBF
SET TALK OFF
*set up loop
STORE T TO WHEN
DO WHILE WHEN
    *set printer
    ACCEPT "Do you want to print out(y/n)?" TO PRINTER
    IF !(PRINTER) = "Y"
        SET PRINT ON
    ENDIF
*set the routine to find answer
USE IUQ
SELECT SECONDARY
USE STOCKTABLE
JOIN TO TEMP1 FOR P.SN = S.SN FIELD P.SN,U:ID, QTY,
        RDRPNT

USE TEMP1
SELECT SECONDARY
USE ITEM
JOIN TO TEMP2 FOR P.SN = S.SN FIELD P.SN,NM,U:ID,QTY,
        RDRPNT

USE TEMP2
sort on stock number
INDEX ON SN TO TEMP2SN
USE TEMP2 INDEX TEMP2SN
DO WHILE .NOT. EOF
    DISPLAY SN,NM,U:ID,QTY,RDRPNT FOR QTY < VAL(RDRPNT)
    SKIP
ENDDC
*to return after query
ACCEPT "Do you want to return to called routine(y/n)?"
    TO ANSWER
IF !(ANSWER) = "Y"
    STORE F TO WHEN

```

```
ELSE
    STOPE T TO WHEN
ENDIF
ENDDO
USE
ERASE
RELEASE
RETURN
```

```
*****HELP.PRG 12/7/84*****
```

```
*AUTHOR: W.D.SONG
```

```
*PURPOSE: This program will provide to user needed
*          information to use thismore effectively.
```

```
*CALLED BY:ALL THE PROGRAMS
```

```
*to clear screen
```

```
ERASE
```

```
?
```

```
?
```

```
?
```

```
?
```

```
?
```

```
? "          Please ask to :  Maj.      H.Y. LEE"
```

```
? "                                Maj.      W.D. SONG"
```

```
?
```

```
?
```

```
?
```

```
?
```

```
? "                                Press any key to continue!"
```

```
?
```

```
?
```

```
SET CONSOLE OFF
```

```
WAIT
```

```
SET CONSOLE ON
```

```
*****
```


APPENDIX H REPORT STATUS EXAMPLES

STATUS OF ITEM QUANTITY =====

| | UNIT | STOCK-NUMBER | NOMENCLATURE | QUANTITY | UNIT-ISSUE |
|-------|-------|-----------------|----------------|----------|------------|
| 00001 | 15ORD | 123456789123456 | M16A1RIFLE | 1666666 | 111.22 |
| 00002 | 20ORD | 123456789123456 | M16A1RIFLE | 1950000 | 111.22 |
| 00003 | 15ORD | 123456789234567 | 105M-MOTOR | 100 | 2222.00 |
| 00004 | 20ORD | 123456789234567 | 105M-MOTOR | 80 | 2222.00 |
| 00005 | 51AMM | 123456789456789 | M16AMMUNITION | 777777 | 205.66 |
| 00006 | 55AMM | 123456789567891 | 105MAMMUNITION | 160000 | 40.40 |
| 00007 | 11QTR | 123456789789123 | COMBAT-SHOSE | 2800 | 555.88 |
| 00008 | 15QTR | 123456789789123 | COMBAT-SHOSE | 2900 | 555.88 |
| 00009 | 11QTR | 123456789912345 | MO-GAS | 900000 | 220.00 |
| 00010 | 15QTR | 123456789912345 | MO-GAS | 864800 | 220.00 |

Do you want to return to called routine(y/n)? :Y

ASSET STATUS OF ITEMS BY BATTALION =====

| UNIT | NOMENCLATURE | QUANTITY | UNIT-PRICE | SUB-TOTAL |
|-------|----------------|----------|------------|--------------|
| 15ORD | M16A1RIFLE | 1666666 | 111.22 | 185366592.50 |
| 20ORD | M16A1RIFLE | 1950000 | 111.22 | 216879000.00 |
| 15ORD | 105M-MOTOR | 100 | 2222.00 | 222200.00 |
| 20ORD | 105M-MOTOR | 80 | 2222.00 | 177760.00 |
| 51AMM | M16AMMUNITION | 777777 | 205.66 | 159957617.80 |
| 55AMM | 105MAMMUNITION | 160000 | 40.40 | 6464000.00 |
| 11QTR | COMBAT-SHOSE | 2800 | 555.88 | 1556464.00 |
| 15QTR | COMBAT-SHOSE | 2900 | 555.88 | 1612052.00 |
| 11QTR | MO-GAS | 900000 | 220.00 | 198000000.00 |
| 15QTR | MO-GAS | 864800 | 220.00 | 190256000.00 |

THE TOTAL ASSET IS:-----> 960491686.30

Do you want to make again(y/n)? :N

APPENDIX I

QUERY EXAMPLES

These are major menu for the logistic database system. And allows you to add,delete, update, query, report, and help. Please choose a number for the function which you want to perform.

- 0 quit the operation.
- 1 add new item or any data.
- 2 delete any data.
- 3 update for transaction data.
- 4 query some information.
- 5 produce periodic reports.
- 6 need help.

Please enter the selected number here :4

This is query menu which prepared for you in this systems.

- 0 quit
- 1 item list(stock-number, nomenclature, unit-issue,unit-price, order-shipping-time, quantity-on-hand, supplier-id)
- 2 unit(unitname, phone, address, city, zip)
- 3 supplier(country, company, location, phone)
- 4 fund(source of fund)
- 5 stock-table(request-objective, safety-level, reorder-point)
- 6 quantity of item by each unit
- 7 the item list which on hand quantity is less than reorder point

Enter the selection here 1::3

| | | | | | |
|-------|----------|--------|-----------------|-----------|--------------|
| 00001 | PUNG-SAN | KOREA | PUNG-SAN AMM-CO | MA-SAN | 22-06-2345 |
| 00002 | DAE-WOO | KOREA | DAE-WOO CORP. | CHANG-WON | 55-33-7865 |
| 00003 | RMT | U.S.A. | REMINGTON | DETROITE | 263-444-7777 |
| 00004 | DAE-WHA | KOREA | DAE-WHA CORP. | DAE-JEON | 44-77-7396 |
| 00005 | KYUNG-IN | KOREA | KYUNG-IN ENERGE | IN-CHUN | 23-45-3673 |

Do you want to another query(y/n)?:Y

This is query menu which prepared for you in this systems.

- 0 quit
- 1 item list(stock-number, nomenclature, unit-issue,unit-price, order-shipping-time, quantity-on-hand, supplier-id)
- 2 unit(unitname, phone, address, city, zip)
- 3 supplier(country, company, location, phone)
- 4 fund(source of fund)
- 5 stock-table(request-objective, safety-level, reorder-point)
- 6 quantity of item by each unit
- 7 the item list which on hand quantity is less than reorder point

Enter the selection here 1::7

Do you want to print out(y/n)?:Y

| | | | | | |
|-------|-----------------|----------------|------|--------|---------|
| 00005 | 123456789456789 | M16AMMUNITION | 5274 | 777777 | 1200000 |
| 00006 | 123456789567891 | 105MAMMUNITION | 5678 | 12345 | 120000 |

Do you want to return to called routine(y/n)?:Y

Do you want to another query(y/n)?:N

Do you want another menu (y/n)? :N

*** END RUN DBASE II ***

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